إقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

تقييم مكافحة العدوى البيئية في وحدات العناية المركزة بمحافظات غزة

Evaluation of Environmental Infection Control at Intensive Care Units in Gaza Governorates

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DECLARATION

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualificati

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة عمادة الدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ **خالد جمال أحمد خضورة** لنيل درجة الماجستير في **كلية *العلوم*/** قسم **علوم بيئية- صحة بيئية**، وموضوعها:

Evaluation of Environmental Infection Control at Intensive Care Units in Gaza Governorates

وبعد المناقشة العلنية التي تمت اليوم الثلاثاء 30 شعبان 1434هـ، الموافق 2013/07/09م الساعة الحادية عشرة صباحًا بمبنى طيبة، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحث درجة الماجستير في **كلية *العلوم*/**قسم **علوم بيئية- صحة بيئية**.

واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق،،،

عميد الدراسات العليا

أ.د. فؤاد علي العاجز

Abstract

***Background*:** Patient safety is one of the most important aspects in evaluating the quality of healthcare. However, healthcare associated infection is a major cause of morbidity and mortality in the critical care units. It is imperative for health care administrators to ensure implementation of the infection control program in healthcare facilities. This study aimed to evaluate the environmental infection control (EIC) measures in the general intensive care units in Gaza.

***Methodology*:** A three-months descriptive cross sectional study was done to evaluate the two main general ICUs in Gaza "Shifa Complex and European Gaza Hospital (EGH)". Walk around fitness checklist was developed to evaluate existing EIC measures. A total of 196 microbiological samples for air, water, and inanimate surfaces were surveyed. Both ambient air and inspiratory air from mechanical ventilator machines (MV) were sampled and cultured for bacterial and fungal count. Also, 20 water specimens were tested for bacterial presence. In addition, 120 swabbed cultures from surfaces and equipments were growing in a pre-enrichment media before incubation. Moreover, a total of 516 reading for temperature and relative humidity were gathered as the most important factors assist in bacterial multiplication. On the other hand, self-administered questionnaire was constructed to assess the health care providers (HCPs) knowledge and attitude toward EIC. Furthermore, HCPs practices were evaluated through an observation checklist.

Results: The study revealed that 62% of the infection prevention and control (IPC) measures in Shifa ICU were unfit, in comparison with EGH ICU (53%). Also, the total bacterial count within indoor air in both ICUs ranged from (1170 to 1470) cfu/m^3 (standard is less than 50 cfu/m^3). Moreover, results revealed the presence of bacterial count that ranged from 73 to 90 cfu/m^3 in the inspired air from MVs of the two units. However, fungal count was 830 cfu/m^3 at Shifa MVs, while free at EGH MVs. The temperature average during day hours was significantly far than the standard in about 4^{o}C, thus 79.73% of HCPs **(P=0.000)** saw that their provided care was affected negatively by unsatisfactory temperature. Relative humidity average was 59% in both units, at a high limit of the international standard. On the other hand, count of total and fecal coliform in all water sources were negative. Although, the study supported using of pre-enrichment media rather than direct culture, (96%) of all inanimate pre-enriched swabbed cultures in Shifa were positive, closely the same as EGH ICU (93%). Bacterial findings were: *Pseudomonas* 48% (n=15), *E-coli* 35% (n=11), and *klebsilla* 12% (n=4) in Shifa ICU. However, both *Pseudomonas and E-coli* were 29% (n=9) in EGH ICU, followed by *klebsilla* 19% (n=6) and then *Staph arues* 16.1% (n=5). Self-administered questionnaire results revealed that nearly 40% of the HCPs acquired influenza followed by chest infection more than twice in the same year. In addition, about 68% of their answers confirm knowledge deficit. Regarding HCPs attitude headed for EIC, 80.68% agreed to use hand rub instead of hand washing (**P-value** 0.001). Also 85% **(P=0.000)** considered the unavailability of aid nurses as a barrier against EIC measures application. HCPs practices were in about 50% compliance. However, nurses were more adherent than physicians in about 7.5%. Nearly 80% of HCPs hadn't experienced supervision of their practices regarding IPC implementation. Both hand hygiene practices and invasive procedures IPC measures were not applied in both ICUs with a percentage of 60%. Healthcare waste disposal remained the highest malpractices reported in the two ICUs.

Conclusions: Periodic monitoring of ventilation system efficiency is needed to ensure optimal indoor air quality. Urgent interventions are required to improve methods of disinfecting the hospital environmental surfaces and equipments especially MVs. Educational courses, auditing and monitoring programs are advised to be more assertive. Addition of the influenza vaccine for all HCPs working in ICUs seems to be an obligatory need as the same as aid nurse and hand rub availability. Advanced healthcare waste and laundry systems necessitate to be developed.

Key words: infection, air, water, environmental surfaces, knowledge, attitude, practices.

الملخص

تقييم مكافحة العدوى البيئية في وحدات العناية المركزة بمحافظات غزة

خلفية: سلامة المريض هي واحدة من أهم جوانب تقييم جودة الرعاية الصحية. ومع ذلك فان العدوى المكتسبة هي أحد الأسباب الرئيسية للمرض والوفيات في وحدات الرعاية الحرجة. ولذلك، فانه يتوجب على مسئولين الرعاية الصحية ضمان تنفيذ برنامج مكافحة العدوى في مرافق الرعاية الصحية. هدفت هذه الدراسة إلى تقييم مكافحة العدوى البيئية في وحدات العناية المركزة العامة في قطاع غزة.

المنهجية:اعتمدت الدراسة أسلوب البحث الوصفي المقطعي لتقييم الوحدتان الرئيسيتان للرعاية الحرجة العامة في غزة (مستشفى الشفاء ومستشفى غزة الأوروبي). تم إعداد قائمة لتقييم تدابير مكافحة العدوى البيئية بشكل روتيني، بالإضافة إلى أخذ196عينة ميكروبيولوجية من الهواء، و الماء، والأسطح البيئية. ولقد تم فحص كلا من البيئة الهوائية داخل وحدات العناية المركزة المغلقة وكذلك الهواء الذي يعطى كشهيق من أجهزة التنفس الصناعي لأعداد البكتيريا والفطريات. وكذلك 20عينة ماء و 152 عينة من الأسطح البيئية بما فيها الأجهزة. من ناحية أخرى، تم جمع 516 قراءة لاثنين من أهم العوامل البيئية التي تساعد على النمو البكتيري و هما درجة الحرارة والرطوبة النسبية. كما تم تصميم استبيان لتقييم المعرفة لدى العاملين حول مكافحة العدوى البيئية عن طريق الإجابة ذاتيا على الاستبيان. كما تم تقييم ممارسات ضبط العدوى لدى مقدمين الخدمات الصحية في الوحدات وذلك من خلال قائمة لملاحظة الممارسات.

النتائج: أوضحت الدراسة أن هناك نسبة 62٪ من التدابير في وحدة العناية المركزة بمستشفى الشفاء كانت غير كافية. بينما 53٪ منها في وحدة العناية المركزة بمستشفى غزة الأوروبي. مجموع عدد البكتيريا في الهواء داخل الوحدات تراوح من (1170 –1470) مستعمرة بكتيرية/م^3 في كلا وحدتيالعناية المركز ة (المعايير تحدد العدد المقبول اقل من 50 مستعمرة بكتيرية/م^3). وعلاوة على ذلك، فإن الدراسة تعكس وجود أعداد من البكتيريا التي تراوحت بين 73 إلى 90 مستعمرة بكتيرية/م^3 في الهواء الذي يعطى كشهيق من أجهزة التنفس الصناعي، أما أعداد الفطريات فكانت 830 مستعمرة فطرية/م^3 في م.الشفاء، وكانت أجهزة التنفس الصناعي في مستشفى غزة الأوروبي خالية تماما من وجود الفطريات.

متوسط درجة الحرارة خلال ساعات النهار كانت أكبر من المعايير بحوالي4 درجات مئوية، ولقد عبر 79.7% من مقدمين الخدمات الصحية عن تأثر خدماتهم المقدمة للمريض سلبيا في أجواء الحرارة الغير مرضية. أما الرطوبة النسبية فكانت (59٪) في الحد الأعلى من المستويات المسموح بها مقارنة بالمعايير العالمية.

وفيما يتعلق بجودة المياه، فان نتائج فحص تلوث الماء بالغائط ووجود البكتيريا كانت سالبة في الوحدتين. وحيث أن الدراسة دعمت استخدام الوسط المغذي للمسحات البكتيريا قبل فترة الحضانة عن التحضين المباشر. حيث كانت نسبة المسحات الملوثة في وحدتيالعناية المركز ة م.الشفاء96٪و الأوروبي93٪. أما البكتيريا المسببة للتلوث فهي: سيدوموناس 48٪، ايشريشيا كولاي 35٪، كليبسيلا 12٪ في م. الشفاء. و كانتكل من السيدوموناس و الايشريشيا كولاي 29٪ في م. عزة الأوروبي، متبوعة بالكليبسيلا19% ثم ستافيلوكوكس اوريس 16٪.

كما أشارت نتائج الاستبيان أن 40٪ من مقدمين الخدمات الصحية أصيبوا بفيروس الأنفلونزا، متبوعا بالتهاب رئوي ثانوي، أكثر من مرتين في نفس العام. كماعبر ت حوالي 68٪ من إجمالي إجابات المشاركين عن نقص في المعرفة. و فيما يتعلق بتقييم توجهات العاملين، أيد 80,68٪ منهم أن فرك اليد بالهلام الكحولي يجب أن يكون بديل لغسل اليدين. كما اعتبر 85٪ (P = 0.000) من العاملين أن عدم توافر مساعدي التمريض عقبة ضد تحقيق مكافحة العدوى، حيث يتم إهدار وقت الممرضين في ممارسة مهام مساعدي التمريض.

بالنسبة لتقييم التزام ممارسات تدابير منع ومكافحة العدوى، كان التزام كل من التمريض والأطباء بهذه الممارسات حوالي50٪. ومع ذلك كان الالتزام أكثر نسبيا بين التمريض عن الأطباء بفارق مئوي حوالي7.5 ٪. في حين عبر حوالي 80٪ من مقدمين الخدمات الصحية عن عدم مرورهم بتجربة الإشراف على أدائهم لتقييم تطبيق ممارسات منع العدوى. كما كان كل من ممارسات غسل اليدين ووسائل مكافحة العدوى للإجراءات المخترقة لجسم الإنسان غير مطبقة بنسبة 60٪. كما سجل سوء التخلص من المخلفات الصحية أكثر التصرفات ممارسة.

الاستنتاجات: هناك حاجة للرصد الدوري لكفاءة نظام التهوية لضمان أفضل لجودة الهواء في الأماكن المغلقة. و هناك حاجة لتدخلات طارئة لتحسين طرق تعقيم الأسطح البيئية والمعدات بالذات أجهزة التنفس الصناعي. برامج التدريب والمراقبة يجب أن تكون أكثر فاعلية. إضافة لقاح الأنفلونزا لجميع العاملين في وحدات العناية المركزة حاجة ملحة، وكذلك توفير مساعدي تمريض و الهلام الكحولي. كما ولا بد من تطوير نظام الغسيل ونظام التخلص من المخلفات الصحية.

الكلمات المفتاحية: العدوى، الهواء ،الماء، الأسطح البيئية، المعرفة ، التوجه، الممارسات.

DEDICATION

To the first teacher of all peoples, prophet MOHAMMED (peace be upon him),

To my Parents, who I owe my life and success

To my Wife; Sahar, who has been a great source of support

To my daughters; Sawsan, Yasmeen, Tasneem and Salsabeel for their hopeful smiles.

To my Brothers and Sisters

With Love and Respect

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List of abbreviations

AIA	American Institute of Architect
AII	Airborne Infection Isolation
CDC	The Centers for Disease Control and Prevention (USA)
CFU	Colony-forming unit
CVC	Central venous catheter
DA- HAI	Device-associated healthcare associated infection
DRBC	Dichloran Rose Bengal Chloramphenicol agar
EGH	European Gaza Hospital
EIC	Environmental infection control
EPA	Environmental Protection Agency
GICU	General Intensive Care Unit
GS	Gaza Strip
HAI	Health-care associated infection.
HBV	Hepatitis B virus
HCPs	Health care providers.
HEPA	High efficiency particulate air
ICU	Intensive Care Unit
IPC	Infection Prevention and Control
MOH	Palestinian Ministry Of Health
NGO's	Non Governmental Organizations
PCBS	Palestinian Central Bureau of Statistics
PHIC	Palestinian Health Information Centre
PPE	Personal Protective Equipment
PVC	Peripheral venous catheter
SPs	Standard Precautions
SPSS	Statistical Package for Social Sciences
TSB	Tryptic soy broth
VAP	Ventilator-associated pneumonia
WB	West Bank
WHO	World Health organization

Chapter I

Introduction

1.1 Background of the study

Worldwide every year, many lives are lost because of the spread of infections in health facilities. Microbial organisms (microbes) make up about 90% of the living matter on this planet. Spreading in the air we breathe, the food we eat, and the water we drink. Also found on our skin, under our fingernails, in our nose and mouth. However, it is rarely implicated in disease transmission except in the immunocompromised population (CDC, 2003).

High-risk areas such as operating rooms, critical care units and transplant units require special ventilation systems. Filtration systems (air handling units) designed to provide clean air should have high efficiency particulate air filters in high-risk areas. Unidirectional laminar airflow systems should be available in appropriate areas in the hospital construction. Ultra clean air is valuable in some types of cardiac surgery, neurosurgery, implant surgery theatres and transplant units (WHO, 2004). Nosocomial infection is a major cause of morbidity and mortality in the critical care units, ventilator-associated pneumonia represents the most prevalent and visible hospital-acquired infection (Zilberberg and Shorr, 2011).

For more than a century, medicine has viewed the microbial world as an enemy that should be destroyed, by practical measures known as “infection control,” and they are designed to prevent the spread of microorganisms from one person to another, or from one site to another on the same person, some infection control practices are rational, and some are ritual, but all are an essential part of daily life in the ICU. It is therefore important for all health care workers, patients, their family members, friends and close contacts to adhere to the infection control guidelines strictly. It is also imperative for health care administrators to ensure implementation of the infection control program in health care facilities (WHO, 2004).

It is very important to protect air-cross infection, improve air quality in surgical intensive care unit and in the design and effect of "local air condition and purification control system" (Su , et. al., 1996). Over 1.4 million people worldwide are suffering from infections acquired at hospitals. Between 5% and 10% of patients admitted to modern hospitals in the developed world acquire one or more infections. The risk in developing countries is 2 to 20 times higher (Pittet and Donaldson, 2006).

The centers for disease control and prevention (CDC) replaced the generic term "nosocomial" with Health-care associated infection (HAI). The CDC defines an HAI as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be no evidence that the infection was present or incubating at the time of admission to the acute care setting (Horan et al., 2008).

HAIs rank as major killers of patients of all ages, particularly among the most vulnerable members of the population. The more sick the patient, the higher the risk of acquiring a HAIs and dying from it. In developed countries, about 5–10% of patients

admitted to acute care hospitals acquire an infection that was not present or incubating on admission. Such HAIs add to the morbidity, mortality and costs that would be expected from the patients underlying disease alone. In the USA, one in 136 hospitalized patients becomes seriously ill as a result of acquiring an infection in hospital. This is equivalent to 2 million cases a year about 80 thousands deaths annually. In England HAI causes 5 thousands deaths each year (WHO, 2005).

Most of these infections can be prevented with readily available, relatively inexpensive strategies such as: Adhering to recommended infection prevention practices, especially hand hygiene and wearing gloves; Paying attention to well-established processes for decontamination and cleaning of soiled instruments and other items, followed by either sterilization or high-level disinfection; and improving safety in high-risk areas where the most serious and frequent injuries and exposures to infectious agents occur (Tietjen et al., 2003).

Recent studies suggest that at least 20% of HAIs could be prevented through infection prevention and control strategies. Infection prevention and control (IPC) programs have been shown to be both clinically effective and cost-effective, providing important cost savings in terms of fewer HAIs reduced length of hospital stay, less antimicrobial resistance and decreased costs of treatment for infections (Ontario Ministry of Health and Long-Term Care, 2011).

The infection prevention and control is a very important goal for all health care facilities. It comes in the context of quality improvement process which aims to provide a safe and effective health care to the clients in order to minimize the morbidity and mortality during the provision of health procedures. It is anticipated that all health providers adhere to standards in their practices. The standards must be part of the knowledge, attitude, and practice of all the health facilities to obtain the clients safety and protection.

Infection control activities must be integrated into the routine activities of the hospital. The management of these activities should be through a Hospital Infection Control Committee with a full time Infection Control Nurse who should coordinate various activities. The Committee should identify priorities, implement the plan and continuously monitor the situation for assuring quality and its continuous improvement (WHO, 2002a).

1.2 Research problem

Infection-control strategies, when consistently implemented are effective in preventing opportunistic environmentally-related infections in ICUs admitted patients. Adherence to proper use of disinfectants, proper maintenance of medical equipment, water-quality standards for daily use, and proper ventilation standards for specialized care environments like airborne infection isolation and nosocomial infection isolation rooms in ICUs will decrease the risk of healthcare associated infections among patients, especially the immune compromised, and healthcare workers. Lack of adherence to established standards and guidance can result in adverse patient outcomes in ICUs.

Increased infection risk is associated with exposure to multiple invasive devices and procedures, increased patient contact with health-care personnel, longer ICU stay which

prolongs the risk of exposure and space limitations that increase the risk of contaminating. Among the patients with ICU-acquired infections, hospital mortality was always higher, regardless of whether or not the patients had had infection on admission **(** Pekka et al., 2006).

A breach in infection control practices facilitates transmission of infection from patients to health care workers, other patients and attendants. It is therefore important for all health care workers, patients, their family members, friends and close contacts to adhere to the infection control guidelines strictly. It is also imperative for health care administrators to ensure implementation of the infection control programme in health care facilities (WHO, 2004).

Use of mechanical ventilation, more invasive lines and nutrition concerns can affect the infection rates. Adherence to aseptic technique, hand hygiene practices, care for invasive lines and ventilator care can do much to reduce the incidence (Kathy, 2002).

1.3 Significance of the study

To the best of our knowledge, there is few studies about this subject in Gaza hospitals. There are limited evaluation criteria in the Palestinian health system about environmental infection control in intensive care units at Gaza governorate. Globally, there are increase incidence, prevalence and morbidity rate of the diseases caused by hospital associated infection. This study will help in reducing the burden on the Palestinian Ministry of Health; by detection of environmental infection risk, and evaluation of existing environmental infection control practices in intensive care units at Gaza governorate. Also by recommending new applicable environmental infection control measures suitable for the existing situation in Gaza hospitals, it is expected to decrease the rate of infectious disease as hepatitis and device associated infection in ICUs and to decrease the impact of environmental infection risks on patients and health care workers.

Finally, according to the researcher experience in intensive care, it seems to be that our ICU health care providers have knowledge deficit about environmental infection risks and its prevention and control measures.

1.4 General objective

This study aims to evaluate the environmental infection control in intensive care units at Gaza governorate.

1.5 Specific objectives

- To develop a local walk around environmental infection control (EIC) checklist based on the existing Palestinian infection prevention and control protocol and international guidelines.
- To evaluate environmental fitness of ICUs at Gaza governorates to EIC guidelines depending on EIC checklist and environmental sampling.
- To assess the knowledge and attitude of health care providers (HCPs) in ICUs toward EIC.
- To evaluate HCPs practice in ICUs toward EIC.

1.6 Context of the study

The demographic, socioeconomic, and political situations greatly impact health and humanitarian organization which working in Gaza strip and West bank, this context influences the services by specific way to suit these situations and to overcome our permanents emergency situation.

16.1 Demographic context

The entire area of historical Palestine is about 27,000 Km^2, Palestine stretching from Ras Al-Nakoura in the north to Rafah in the south. Palestine is bordered by Lebanon in the north, the Gulf of Aqaba in the south, Syria and Jordan in the east and by Egypt and the Mediterranean Sea in the west. Palestine was placed under the British mandate in 1919 which had been terminated by Israel establishment in 1948 in implementing the Balfour Declaration of 1917 had promised a homeland for Jews. The result of implementation of that promise was the uprooting of most of the Palestinians from their cities, towns, and Villages and the migration to the West bank, Gaza strip, Jordan, Lebanon, Syria, and many other countries (Abu-Lughod, 1971).

Now Palestine is limited to two geographically separated areas, Gaza Strip (GS), and West Bank (WB), with a total area 6279 km^2, which represents 22% of historical Palestine (MOH, 2006).

Based on estimates prepared by PCBS according to the results of the Population, Housing and Establishment Census of 2007, the total population of the Palestinian territory at mid-2011 was about 4.17 million; 2.12 million males and 2.05 million females. The estimated population of West Bank was 2.58 million of which 1.31 million males and 1.27 million females, while the estimated population of GS totaled 1.59 million of which 806 thousand males and 782 thousand females. The percentage of urban population mid-2011 was about 73.8%, while the percentage of population in rural and camps areas was 16.9% and 9.3% respectively. Data revealed that the population of the Palestinian territory is a young population; the percentage of individuals aged (0-14) constituted 40.8% of the total population at mid 2011of which 38.9% in West Bank and 44.1% in GS. The elderly population aged (65 years and over) constituted 2.9% of the total population of which 3.3% in the West Bank and 2.4% in

Gaza Strip of mid-2011. Population density of The Palestinian territory is generally high at 693 persons/Km^2, particularly in GS is 4,353 persons/km^2 compared to lower population density in West Bank at 456 persons /Km^2 at mid-2011 (PCBS, 2007).

16.2 Gaza Strip

Gaza Strip is a narrow land, located on the southwest of Palestine on the coast of the Mediterranean Sea. GS is a high crowded area, where approximately 1.5 million live in 378 km2, with an estimated density of about 4,000 people per square kilometer. The population is concentrated in 7 towns, 10 villages and 8camps (PCBS, 2007). The density is increases in refugee camps (UNRWA, 2005). Gaza Strip is divided into five governorates, North of Gaza, Gaza city, Mid-Zone, Khan-Younis and Rafah. The population under 15 years old in GS represents 49% and those of 65 years and more represent 2.5% (MOH, 2006).

16.3 Socio-economical context

The Palestinian economy is severely depressed compared with the pre-intifada period. The World Bank estimated the gross domestic production per capita (GDP) to be 23 percent lower than that in 1999. After accounting for population growth, real GDP per capita was 35 percent below its pre-intifada level (World Bank, 2004). The Palestinian Authority fiscal situation has become increasingly unsustainable mainly as a result of uncontained government consumption, in particular a rapidly increasing public sector wage bill, expanding social transfer schemes and rising "net lending". In addition, the depressed economy led to lower tax revenues level (World Bank, 2006).

1.7 Palestinian health care system

The health care system in Palestine is complex and unique under Israeli occupation who strongly influences the health care system in Palestine. The consequences of closures and separation formed a great challenge for the Ministry of Health by creating obstacles regarding the accessibility to health care services and affect the unity of the health care system in all Palestinian Governorates (MOH, 2004).

There are four major healthcare providers: the Ministry of Health, UNRWA, NGOs, and the private sector (non- and for-profit hospitals). The MOH is the main health care provider; it provides primary, secondary, and tertiary care and purchases some services from private providers domestically and abroad. The Palestinian's overall health is relatively good compared to several countries of the region, major outbreaks of diseases are prevented and health indicators also improved by effective health services (WHO, 2006).

1.7.1 MOH hospitals and hospital beds

In 2005, access to hospital facility was made available in the entire 15 governorates where the hospital /100,000 population ratio is 2.02 (1.6 in the GS and 2.3 in the WB). The MOH owns and operates 22 hospitals (10 in GS and 12 in the WB), furnished with 2,815 beds (1,499 in GS and 1,316 in the WB), (MOH, 2005).

17.2 Intensive care units beds in MOH hospitals

General Intensive Care Unit (G.I.C.U) are 33 in WB and 25 in GS. Intensive Coronary Care Unit (I.C.C.U) are 13 in WB and 16 in GS. Intensive Medical Unit (I.M.U) is 8 in WB and zero in GS. Burns Units are 9 in WB and 8 in GS and 17 in WB. Pediatric ICU is zero in WB and 14 in GS (MOH, 2005).

1.7.3 Shifa commutative medical center (Shifa Complex)

Shifa commutative medical center is the biggest in Palestine. It's located in the west part of Gaza. It was established on 1946, developed over years until it reaches to higher universal level over 45,000 thousand square meters and located on the western side of the middle of Gaza City. It consist of three hospitals surgery, Internal Medicine and maternity. The health services provided to citizens through the three hospitals and include the different patients referred by reception and emergency departments or clinics by primary care. Where it is transferred to internal departments or hospital outpatients review the complex. Total number of Beds are 590 and while total number of employees are about 1600 divided as follows: Nursing 36.5%, doctors 35.6%, administrators and technicians in different disciplines17.7%. The occupancy rate in the complex is about 82%.

Surgery hospital is the largest hospitals in the complex includes many sections that accommodate a large number of patients, including three adult Intensive Care Units. The total number of ICU beds in the complex is 23 units including general intensive care unit, burns care unit, internal medicine (not functioned yet) and cardiac surgery care unit, as well as 12 bed for the intensive cardiac care units (ICCU).

1.7.4 Intensive care unit of surgery hospital at Shifa complex

The intensive care unit of Surgery hospital at Shifa is the first and the largest intensive care units at the level of the Gaza Strip and the West Bank. By its cadres different intensive care units in Gaza Strip were opened. It is the central section for transfer of difficult cases from all hospitals in the Gaza strip, as well as inpatients by the complex of the three hospitals. It consists of 11 beds, one of them is isolation unit.

1.7.5 European Gaza Hospital (EGH)

Hospital began as a grant of the European Union to the Palestinian people at the end of the first intifada in 1989. in this period there was not any legal authority so UNRWA has been assigned to create this hospital by European funded. Since the arrival of the Palestinian Authority as the legitimate authority in the country began a dialogue to transfer ownership of the hospital to the Ministry of Health. On October 1997 provides for the transfer of ownership of the hospital to the Ministry of Health, that the European Union to complete the necessary funding, and provided that during the transition from an international team.

In July 1999, the international team working at the hospital with a local Arab team and effectively ended his work in October 2000 and continued management of the Arab local team. The total number of admissions for the first half year is 7697 case of internal divisions, and increase the number of admissions for the year 2010 by 169 cases a monthly rate increase of 28 cases. Bed occupancy rate during the past six months is

94% increase the occupancy rate of 6% for The first six months in 2010 and 19% for the first six months in 2009 (EGH, 2011).

1.7.6 Intensive care unit at EGH

The general intensive care unit of EGH hospital is serves all departments in the hospital and also Nasser hospital for some specialty as neurosurgery. Its staff has training in Maqased hospital ICU in Jerusalem and Shifa complex ICU in Gaza, It consists of 6 beds, with occupancy rate of 75% and 5 days is the average day of stay (EGH, 2011).

1.8 Operational definitions

Infection: It is defined as the transmission of microorganisms into a host after evading defense mechanisms, resulting in the organism's proliferation and invasion within the host tissues (CDC, 2007).

Infection prevention and control: Evidence-based practices and procedures that, when applied consistently in health care settings, can prevent or reduce the risk of transmission of microorganisms to health care providers, other clients, patients, residents and visitors(Ontario Ministry of Health and Long-Term Care Provincial Infectious Diseases Advisory Toronto, Canada, 2010).

Protocol: a formal set of rules and procedures to be followed during a particular research experiment, course of treatment, etc. (Your dictionary, 2011).

Nosocomial infection or HAIs: Hospital Associated Infections (HAI) or nosocomial infections are those infections that were neither present nor incubating at the time the patient was admitted to the health care facility. The majority of HAI become evident 48 hours or more following admission. However, it may not become clinically evident until after discharge (WHO, 2006).

Health care provider: Any person delivering care to a client/patient/resident. This includes, but is not limited to, the following: emergency service workers, physicians, dentists, nurses, respiratory therapists and other health professionals, personal support workers, clinical instructors, students and home health care workers (Ontario Ministry of Health and Long-Term Care, 2011).

Personal Protective Equipment (PPE): Clothing or equipment worn for protection against hazards. (Ontario Ministry of Health and Long-Term Care, 2011).

Intensive Care Unit (**ICU**): also known as a Critical Care Unit (CCU), Intensive Therapy Unit or Intensive Treatment Unit (ITU), is a special department of a hospital that provides intensive-care medicine. Intensive Care Units cater to patients with the most serious injuries and illnesses, most of which are life-threatening and need constant, close monitoring and support from specialist equipment and medication in order to maintain normal bodily functions. They are staffed by highly trained doctors and critical care nurses who specialize in caring for the most severely ill patients (Intensive Care Society, 2013).

Compliance: It is defined as the extent to which the patients' behavior matches the prescriber's recommendations. However, its use is declining as it implies lack of patient involvement (Horne et al., 2005).

Prevalence: prevalence is a frequently used epidemiological measure of how commonly a disease or condition occurs in a population. Prevalence measures how much of some disease or condition there is in a population at a particular point in time. The prevalence is calculated by dividing the number of persons with the disease or condition at a particular time point by the number of individuals examined (Le & Boen, 1995).

Incidence: The incidence of a disease is another epidemiological measure. Incidence measures the rate of occurrence of new cases of a disease or condition. Incidence is calculated as the number of new cases of a disease or condition in a specific time period (usually a year) divided by the size of the population under consideration who are initially disease free (Le & Boen, 1995).

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Chapter II

Conceptual framework and literature review

Traditionally, three different categories of risk factors associated with nosocomial infection (NI) acquisition have been described; factors inherent to patient, to invasive procedures and to hospital environment. The study of these factors can guide the selection, implementation, and evaluation of control measures for this type of infection (Arantes et al., 2003). However, extensive investigations often fail to yield specific sources, and the clusters may spontaneously disappear. This suggests that environmental or host factors that have yet to be identified also contribute to the acquisition of NIs (Zafar et al., 2001).

2.1 Conceptual framework

The researcher developed his own conceptual framework in order to guides the research process, organizes the work and makes the research findings meaningful. The researcher builds up the conceptual framework (Figure 2.1) to address the main domains of the study in accordance with previous studies. It includes three factors which affect the infection prevention and control practices at the ICUs. Which classified as environmental infection control measures, structural and managerial element and individual elements.

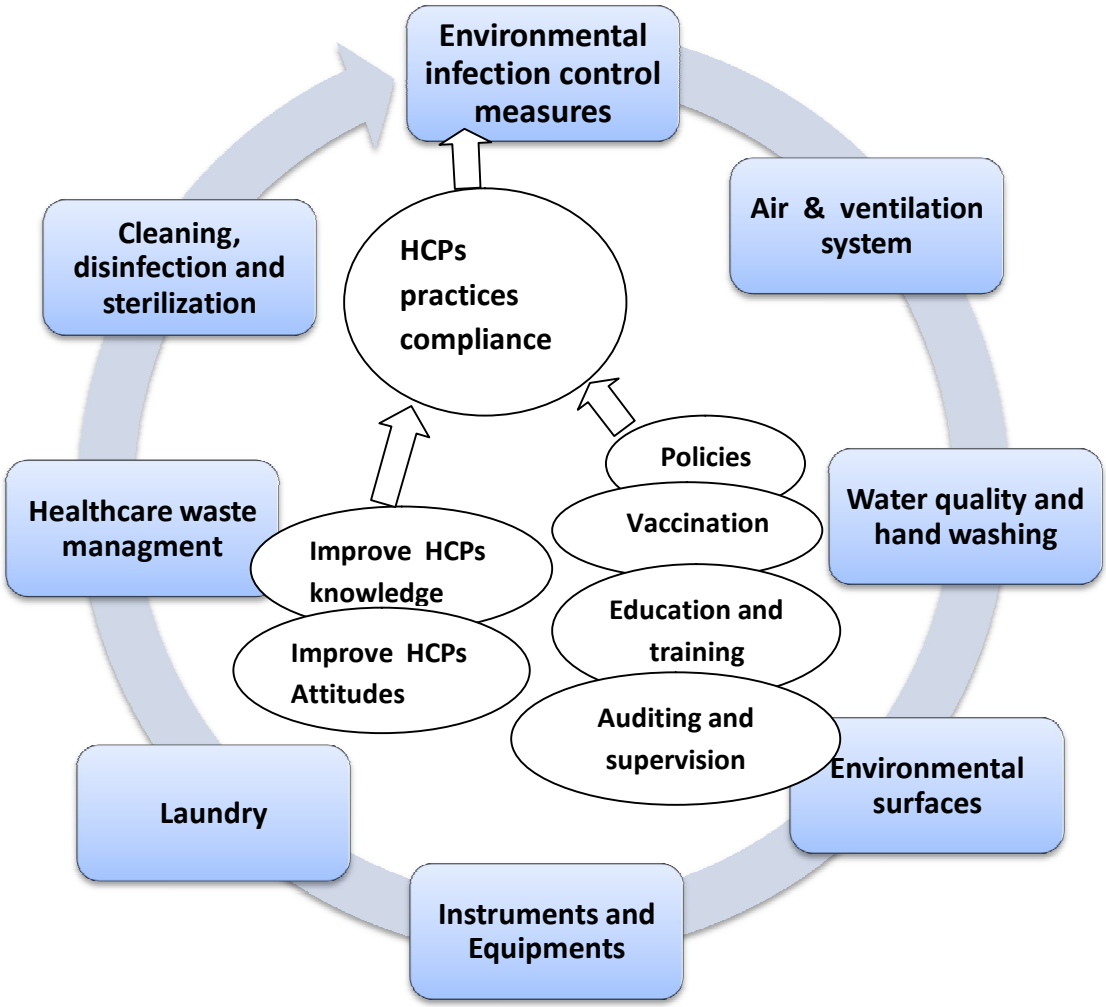


Figure 2.1: Conceptual Framework

The first factor is **environmental infection control measures**, which consists of a number of variables which are air and ventilation system quality, water quality, environmental surfaces, laundry, healthcare waste management, instruments and equipments cleaning, and cleaning aids "antiseptic, disinfection and sterilization".

The second factor is **structural and managerial elements**, which consists of a number of variables which are policies, education and training programs, frequencies of vaccination, frequent of diseases and injures, auditing and supervision, availability of resources and barriers overcome.

The third factor is **individual elements**, which consists of a number of variables which are HCPs knowledge, attitudes and HCPs practices compliance to infection control policies.

2.2 Literature Review

2.2.1 Religion and culture

Islam places great emphasis on cleanliness (Lawrence, 2001), in both its physical and spiritual aspects and the Qur'an gives clear instructions as to how this should be carried out. With the exception of the ritual sprinkling of holy water on hands before consecration of the bread and wine and the washing of hands after touching the holy oil, the Christian faith does not include definite indications for hand cleansing (Muftic, 2006). In general, the indications given by Christ's example refer more to spiritual behavior, but the emphasis on this specific viewpoint does not imply that personal hygiene and body care are not important in the Christian way of life. Similarly, the Buddhist faith has no specific indications regarding hand hygiene in daily life or during ritual occasions (Allegranzi et al., 2009)

2.2.2 Safe ICU environment

Critical care is the specialized medical care of patients with or at high risk for life-threatening, or "critical," conditions requiring constant monitoring and comprehensive care consisting of complex therapies and interventions. Most hospitalized patients with critical conditions are cared for in ICUs, patient care areas designed to provide extraordinary treatment by specially trained healthcare professionals, often with the use of high-tech equipment. More than three-quarters of acute care hospitals in the United States provide critical care services, and the national number of ICU beds continues to increase each year (Halpern et al., 2004).

Critical care setting is the most complex environment in the healthcare facility. While other units may need to manage one or two of challenges at a time, critical care settings must manage them all simultaneously while remaining focused on the delivery of safe patient care. These challenges include managing a high-tech environment and ensuring staff competency in operating the equipment, providing high-quality care to the facility's sickest patients, and tending to the needs of staff members working in a very stressful environment. The interplay of high technology and high acuity in critical care makes the intensive care unit (ICU) environment one of the most complicated for healthcare facilities (ECRI, 2007).

Most ICU patients are immunocompromised, whether from pathologies (e.g. hepatic failure, leukemia, AIDS) or treatments (immunosuppressive drugs), making them susceptible to opportunistic infection from organisms colonizing (but not necessarily infecting) healthier people. Each member of staff is a potential carrier of infection (Ling, 2011).

In Rosenthal et al, (2006) study, determined the extra mortality (EM) of the health care associated infections (HAI) at intensive care units (ICU) of a hospital in Argentina. They analyzed the extra mortality among patients with central vascular catheter associated blood stream infection (CVC-BSI), mechanical ventilator associated pneumonia (VAP), and catheter associated urinary tract infection (CA-UTI). The study has identified CVC-BSI, VAP and CA-UTI are significantly associated with higher mortality (Rosenthal et al., 2006).

The purpose of Standard Precautions (SPs) is to break the chain of infection focusing particularly but not exclusively on the mode of transmission, portal of entry and susceptible host sections of the chain. Aseptic technique and antibiotic prophylaxis while not components of SPs are other key practices used to break the chain of infection at the infectious agent, reservoir and portal of exit sections of the chain (CDC, 2007).

2.2.2.1 Standard precaution

Standard Precautions (SPs) are evidence based clinical work practices published by the Centre of Disease Control (CDC) in 1996 and updated in 2007 that prevent transmission of infectious agents in healthcare settings. SPs require all HCWs to:

A. assumes that every person is potentially infected or colonized with an organism that could be transmitted in the healthcare setting.

B. apply a set of work practices to blood, all body fluids except sweat, mucous membranes and non-intact skin including: hand hygiene, use of PPE, management of spillages of blood and body fluids , appropriate patient placement, management of sharps, safe injection practices, respiratory hygiene and cough etiquette, management of needle sticks injuries, management of waste, management of laundry, decontamination of reusable medical equipment, decontamination of the environment.

2.2.3 History of infection prevention and control

Healthcare had its first IPC champion by Florence Nightingale "the mother of nursing". While she had no scientific understanding of asepsis, her research into hospital sanitary problems made her a firm believer in pure air, pure water, efficient drainage, cleanliness, and light. Nightingale's firm belief in preventive medicine led to an established standard of formalized cleanliness and sanitation in hospitals and the military. She observed that open windows interfered with the ventilation of hospital wards and allowed air from the wards to pass into the corridors. Nightingale believed that respiratory secretions were potentially dangerous, especially among the sick and that the sick should be isolated (AJIC, 2007).

Around the same time period, an obstetrician in Vienna, Dr. Ignaz Semmelweis, demonstrated more formally that routine hand washing could prevent the spread of puerperal fever. He noted that maternity patients were dying at such an alarming rate that they begged to be sent home from the hospital to deliver with a midwife. The death rate was five times higher for mothers who delivered in the hospital than for mothers who delivered at home. Semmelweis' analysis of the outbreaks of puerperal fever in his hospital revealed that medical students, who were responsible for deliveries in Division I, often performed autopsies before assisting in deliveries while midwives, who worked in Division II, did not. He theorized that disinfecting hands could prevent transmission of infection from a diseased cadaver to a pregnant (AJIC, 2007).

2.2.4 Infection prevention and control

CDC replaced the generic term "nosocomial" with Health-care associated infection (HAI). The CDC defines an HAI as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be

no evidence that the infection was present or incubating at the time of admission to the acute care setting (Horan et al., 2008). WHO is less conservative than CDC in terminology; Nosocomial infections, known also as hospital-acquired infections, hospital-associated infections, and hospital infections (WHO, 1999). Hospital-acquired infections are infections that are not present in the patient at the time of admission to hospital but develop during the course of the stay in hospital (Ducel et al., 2002).

Infection prevention and control refers to measures, practices, protocols and procedures aimed at preventing and controlling infections and transmission of infections in health care settings. HAIs need to be properly managed in order to prevent transmission of organisms amongst patients, HCWs and visitors. HCWs and visitors may be sources of infections that may result in facility-based outbreaks. IPC measures are a combination of interventions and activities, ranging from hand hygiene, aseptic technique, waste management, rational antibiotic use, cleaning and the use of chemical cleaning agents, pest and rodent control, food handling, linen handling and management, isolation, surveillance, risk management, the use of PPE, employees‟ immunization programs and personnel hygiene. Laxity in application of any of these dimensions can result in significant negative public health consequences. Emerging and re-emerging diseases, and the increase of resistant organisms, which undermine advances and progress made in the fight against diseases, are posing serious challenges to health care systems in both the developed and developing countries. An IPC policy is required to provide guidance to HCWs as to ensure safe management of infectious conditions (Health Department of South Africa, 2007).

Hospital Associated Infection (HAI) or nosocomial infections are those infections that were neither present nor incubating at the time the patient was admitted to the health care facility. The majority of HAI become evident 48 hours or more following admission. However, it may not become clinically evident until after discharge (WHO, 2002a).

HAI remains a major issue of patient safety. It complicates a significant proportion of patient care deliveries, adds to the burden of resource use, and contributes to unexpected deaths. Early infection control pioneers showed that surveillance and prevention programs can be successful and have set the scene for today's infection control activities. Parameters for success include those to recognize and explain HAIs and implement interventions to decrease infection rates and limit antimicrobial resistance spread. Current major challenges facing infection control programs are reviewed with an emphasis on recent trends in health care delivery systems, together with some vision on future activities and interactions toward such changes. Benchmarking of infection rates is considered inevitable, and, thus, surveillance strategies, adapted to changing health care systems, should improve and emphasize intervention and standardization (Pittet, 2005).

2.2.5 Economic burden and long of stay

In the study which had conducted in China in 2012 by Bijie et al., which studded the burden of device-associated health care associated infection (DA- HAI). This study examined the DA-HAI rate and evaluated its association with device use (DU), length of stay (LOS), and mortality in intensive care units (ICUs) in 4 Chinese hospitals. In the study ICUs, VAP and CLABSI rates were higher than CDC/NHSN’s reported data, and LOS and mortality were increased. Compared with the CDC/NHSN and INICC data,

the pooled DU ratio for MV was similar, and DU ratios for CL and UC use ratios were slightly higher (Bijie et al., 2012).

Preventing CRBSIs can improve patient care while reducing hospital stays, costs, and possible mortality. CVL bundles are fairly easy to perform with reproducible results (Kim et al., 2011).

Hospitalized adults with Candida bloodstream infections have longer hospital stays and higher costs of care compared with those without candidemia. Rentz et al in 1998 reported that candidemia results in approximately 1-month longer hospital stays and up to $45,000 in additional costs. Our unadjusted comparisons revealed longer inpatient stays and higher costs with C glabrata compared with C albicans in patients with early evidence of infection, in whom costs and length of hospital stay before the development of infection did not influence comparisons (Moran et al., 2010).

The HAIs burden the health system a high cost, instead of recovery of clients in a few days it takes long days and affect the health system and clients at the same. HAIs do place a high burden of cost upon health services by prolonging hospitalization, increasing the use of antimicrobial treatment and increasing the number of surgical and medical interventions per patient (Health department of South Africa, 2007).

In the USA, the risks of acquiring these infections have risen steadily over the last decades with accompanying extra costs estimated at US$ 4500–5700 million a year. In England, HAIs are estimated to cost £1000 million annually to the National Health Service. The costs of HAIs vary from country to country, but are substantial everywhere. In Trinidad and Tobago (in Caribbean) they represent 5% of the annual budget of a country hospital, and in Thailand some hospitals spend 10% of their annual budget on the management of infections. In Mexico, these costs represent 70% of the entire budget of the Ministry of Health (WHO, 2005).

Prolonged stay not only increases direct costs to patients or payers but also indirect costs due to lost work. The increased use of drugs, the need for isolation, and the use of additional laboratory and other diagnostic studies also contribute to costs. HAIs add to the imbalance between resource allocation for primary and secondary health care by diverting scarce funds to the management of potentially preventable conditions (WHO, 2002b).

In the study by Vincent et al. (2002), 'European Prevalence of Infection in Intensive Care' (EPIC), is the most substantial study of ICU infection The study found that most ICUs mixed medical and surgical patients so that immunocompromised but uninfected surgical patients could be exposed to bacteria from medical patients admitted for treatment of infection. Forty-five per cent of patients stayed over 5 days, with infection rates tripling after 3– 4 days. Patients staying longer were usually sicker, but exposure to secondary infections compounded mortality. The report suggested that one-half of nosocomial infections were preventable, with risks increasing when units had more than eleven beds. The two most prevalent organisms identified by EPIC were *Staphylococcus aureus* (30.1 per cent) and *Pseudomonas* sp. (32.1 per cent) (Vincent et al*.,* 2002).

2.2.6 Modes of transmission

Hand washing may itself perpetuate outbreaks if hand-washing agents become contaminated (Moore, 2004). The most common mode of transmission, contact transmission is divided into two subgroups: direct contact and indirect contact (Bolyard et al., 1998).

2.2.6.1 Direct contact transmission: occurs when microorganisms are transferred from one infected person to another person without a contaminated intermediate object or person. Opportunities for direct contact transmission between patients and healthcare personnel have been summarized in the Guideline for Infection Control in Healthcare Personnel and include:

• Blood or other blood-containing body fluids from a patient directly enters a caregiver's body through contact with a mucous membrane or breaks (i.e., cuts, abrasions) in the skin (Beltrami et al., 2003).

• Mites from a scabies-infested patient are transferred to the skin of a caregiver while he/she is having direct ungloved contact with the patient's skin (Obasanjo et al., 2001).

• A healthcare provider develops herpetic whitlow on a finger after contact with HSV when providing oral care to a patient without using gloves or HSV is transmitted to a patient from a herpetic whitlow on an ungloved hand of a healthcare worker (HCW) (Avitzur et al., 2002).

2.2.6.2 Indirect contact transmission: involves the transfer of an infectious agent through a contaminated intermediate object or person. In the absence of a point-source outbreak, it is difficult to determine how indirect transmission occurs. However, extensive evidence cited in the Guideline for Hand Hygiene in Health-Care Settings suggests that the contaminated hands of healthcare personnel are important contributors to indirect contact transmission. Examples of opportunities for indirect contact transmission include:

• Hands of healthcare personnel may transmit pathogens after touching an infected or colonized body site on one patient or a contaminated inanimate object, if hand hygiene is not performed before touching another patient (Duckro et al., 2005).

• Patient-care devices (e.g., tourniquets, stethoscopes, thermometers, glucose monitoring devices, etc) may transmit pathogens if devices contaminated with blood or body fluids are shared between patients without cleaning and disinfecting between patients (CDC, 2005).

2.2.7 Environmental infection in intensive care units

Infection is a common problem for patients in ICUs and is associated with considerable morbidity, mortality, and costs (Esteban et al., 2007) Infection and related sepsis are the leading cause of death in non cardiac ICUs, with mortality rates that reach 60% and account for approximately 40% of total ICU expenditures (Vincent et al., 2002)

Infection incurs high costs: in human life, in morbidity (quality of life for survivors) and financially. Antibiotics and other medical treatments can reduce morbidity and mortality, but preventing infection is humanly (and usually financially) preferable. Hygiene is helped by adequate and appropriate facilities, including sufficient

washbasins, aprons and unit guidelines and protocols. All multidisciplinary team members should be actively involved in making decisions, but nurses have an especially valuable role in coordinating and controlling each patient's environment. Prevention can literally be 'life-saving'. Problems from infection are likely to escalate; continuing vigilance and care can minimise infection risks and the spread of microorganisms. The importance of nursing to infection control is emphasised through its inclusion in the Standards of Care for Critical Care Nursing (Vincent et al., 2009).

Ventilator-associated pneumonia (VAP) is a serious complication of invasive mechanical ventilation (MV) and is the most frequent intensive care unit (ICU)-acquired infection. It affects 9% to 24% of patients intubated for longer than 48 hours, is associated with significant morbidity and mortality, and leads to consider- able increase in resource utilization. As a result, prevention of VAP has become a focus of several patient safety initiatives, With the aim of VAP elimination and zero tolerance (Al-Dorzi et al., 2012).

In addition, an international Study of the prevalence and outcomes of infection in intensive care units by (Vincent; et al., 2009) they believed that infection is a major cause of morbidity and mortality in intensive care units (ICUs) worldwide. However, relatively little information is available about the global epidemiology of such infections. The study results indicated that the lungs were the most common site of infection, accounting for 64% of infections, followed by the abdomen (20%), the bloodstream (15%), and the renal tract/genitourinary system(14%). In the study conclusion the infections was common in patients in contemporary ICUs, and risk of infection increases with duration of ICU stay. In this large cohort, infection was independently associated with an increased risk of hospital death (Vincent; et al., 2009).

American study found that one-quarter of hospital infections occurred in ICUs, and that ICUs caused most hospital outbreaks of infection. Infection rates climb steeply after a few days on ICU. Alcock and Ledingham (1990) suggesting that four-fifths of ICU patients develop infection after five or more days an ironic contrast to Nightingale's -1859- suggestion that hospitals should do the sick no harm. More than 4 million U.S. patients receive care in ICUs each year, at an annual cost of more than *$180 billion*, making ICUs a high-volume and high-cost environment - a challenging combination for ICU staff, whose primary goal is safe patient care (ECRI, 2007).

Critically ill patients are at high risk for complications due to the severity of their medical conditions, the complex and invasive nature of critical care treatments and procedures, and the use of drugs and technology that carry risks as well as benefits. Complications contributing to morbidity and mortality in ICUs include those related to the performance of invasive procedures, ventilator-associated pneumonia (VAP), infections such as central-vascular-catheter-associated bloodstream infection, and pressure ulcers. Omission of therapies also accounts for significant and preventable morbidity, mortality, and costs associated with ICU care (Pronovost et al., 2002).

ICU design should be approached by a multidisciplinary team consisting of, but not limited to, the ICU medical director, the ICU nurse manager, the chief architect, hospital administration, and the operating engineering staff (Piergeorge et al., 1983). The engineers should be experienced in the design of mechanical and electrical systems for hospitals, especially critical care units. The design team should be expanded as appropriate by adding members of other hospital departments working with and/or in

the critical care unit, to assure that the design meets its intended function. In addition, environmental engineers, interior designers, staff nurses, physicians, and patients and families may be asked for comments on how to provide a functional and user-friendly environment (Suzanne et al., 1995).

2.2.7.1 Air and ventilation system

There is a growing body of evidence that the aerial dispersion of some nosocomial pathogens can seed widespread environmental contamination, and that this may be contributing to the spread infection in hospital wards. Acinetobacter spp in particular appear to conform to this model, with numerous outbreaks attributed to aerial dissemination. This suggests that the clinical role of general ward ventilation may have been underestimated and that through improved ward ventilation, it may be possible to reduce environmental contamination and thus reduce nosocomial infection rates (Beggs et al., 2008)

Both the UK and US guidelines assume the use of dilution ventilation when ventilating general ward spaces. Such a strategy relies on good air mixing within the room space and generally is achieved by supplying clean filtered air in through diffusers in the ceiling and extracting contaminated air out through grills also located in the ceiling. With this type of ventilation system and full air mixing, the steady-state contaminant level, Ce, achieved in the ward space can be calculated as Ce = qc/Qv ,where qc is the generation rate of biological contaminants in the room space (cfu/s) and Qv is the volume flow rate of the ventilation air (m3/s). This equation shows that the greater the ventilation air flow rate, the lower the contaminant concentration level in the room air, and the greater the air change rate, the shorter the average residence time of bioaerosol particles in the room space. At a ventilation rate of 2 AC/h, the average particle residence time is 30 minutes; increasing the rate to 6 AC/h decreases the average residence time to 10 minutes. (Beggs et al., 2008)

Suitable and safe air quality must be maintained at all times. A minimum of six total air changes per room per hour are required, with two air changes per hour composed of outside air. For rooms having toilets, the required toilet exhaust of 75 cubic feet per minute should be composed of outside air. Central air-conditioning systems and recirculated air must pass through appropriate filters. Air-conditioning and heating should be provided with an emphasis on patient comfort. For critical care units having enclosed patient modules, the temperature should be adjustable within each module (Suzanne et al., 1995).

Air-handling systems in healthcare facilities recommended infection control and ventilation requirements for Airborne Infection Isolation (AII) rooms, as

1. providing ventilation to ensure >12 ACH for renovated rooms and new rooms, and >6 ACH for existing AII rooms (Dolin et al., 2000).
2. Direct exhaust air to the outside, away from air-intake and populated areas. If this is not practical, air from the room can be recirculated after passing through a HEPA filter (CDC, 2003).

Ventilation areas shall be designed to provide directed airflow from the cleanest patient care area to less clean areas. These rooms shall be protected with HEPA filters at 99.97 percent efficiency for a 0.3 μm sized particle in the supply airstream. These interrupting

filters protect patient rooms from maintenance-derived release of environmental microbes (CDC, 2003).

Patient visiting activity impacts the indoor air quality of the ICU environment, especially in terms of coarse particle concentrations. Periodic monitoring of ventilation system efficiency is needed to ensure optimal indoor air quality (Chin-Sheng et al., 2009).

2.2.7.1.1 Indoor climate in ICU

Temperature should be maintained between 21°C and 24°C and humidity between 30% and 60% to inhibit bacterial multiplication (CDC, 2007). Heating, ventilation, and air conditioning systems in health-care facilities are designed to maintain the indoor air temperature and humidity at comfortable levels for staff, patients, and visitors; control odors; remove contaminated air; facilitate air-handling requirements to protect susceptible staff and patients from airborne health-care–associated pathogens; and minimize the risk for transmission of airborne pathogens from infected patients. Decreased performance of healthcare facility systems, filter inefficiencies, improper installation, and poor maintenance can contribute to the spread of health-care–associated airborne infections (WHO,2004).

High value of temperature and relative humidity increase infection rate in plants tissue as (Curtis et al., 2012) said that the higher value of RH (100%) appeared to increase the rate of colonization, in particular at 20 and 25 °C . The presence of wounds on grape skin dramatically favored infection of berries by A. carbonarius strain A1102, since unwounded berries showed very low levels of infection at all conditions of RH and temperature tested (Curtis et al., 2012).

This study evaluated the characteristics and weekly variations in indoor air in a medical intensive care unit (ICU) in northern Taiwan for 1 year. It also investigated the impact of patient visiting activities on the indoor climate in the medical ICU. A 4-bed room with patients in the medical ICU was selected for long-term air monitoring of air temperature and relative humidity. The result conclusion was, patient visiting activity impacts the indoor air quality of the ICU environment. Periodic monitoring of ventilation system efficiency is needed to ensure optimal indoor air quality., During the environmental sampling period, air temperature ranged from 21.28C to 25.88C, relative humidity ranged from 58% to 74% (Chin-Sheng et al., 2009).

2.2.7.1.2 Bacteria and Fungi count

Many fungi may cause allergic reactions and increase asthma symptoms prevalence and severity. One susceptible, vulnerable population subgroup of increasing size in industrialized countries and of public health concern who spends the majority of their time at home is older adults. Older adults diagnosed with chronic obstructive pulmonary disease (COPD) are at risk of exposure to fungi. The results of this pilot study are novel and suggest adverse effects of exposure inside homes to certain fungal species (Derek et al., 2012).

Bioaerosols from numerous sources have been implicated in respiratory diseases, investigated the impact of patient visiting activities on the indoor climate in the medical ICU. A 4-bed room with patients in the medical ICU in northern Taiwan for 1 year, was selected for long-term air monitoring, bacteria, and fungi were measured. The measured

bacteria and fungi concentrations varied among the surveyed weeks. The peak concentrations of indoor bacteria and fungi were found in June (7236 cfu/m^3 for bacteria and 7807 cfu/m3 for fungi), October (3869 cfu/m3 for bacteria and 5954 cfu/m3 for fungi), and December (2964 cfu/m^3 for bacteria and 11,654 cfu/$m^3$for fungi). Approximately 27% of the bacterial samples and 17% of the fungal concentrations exceeded 1000 cfu/m^3 (Chin-Sheng et al., 2009).

2.2.7.1.3 Mechanical ventilator and ventilator-associated pneumonia (VAP)

A mechanical ventilator is a machine that generates a controlled flow of gas into a patient's airways. Oxygen and air are received from cylinders or wall outlets, the gas is pressure reduced and blended according to the prescribed inspired oxygen tension (FiO2), accumulated in a receptacle within the machine, and delivered to the patient using one of many available modes of ventilation (Neligan, 2012).

Mechanical ventilators are an example for medical equipment that collects moisture. Continuous inspection, cleaning and regular replacement of the filters of all appliances for ventilation and humidifiers is special duties for maintenance (WHO, 2002).Ventilator-associated pneumonia (VAP) due to multidrug-resistant (MDR) pathogens is a leading healthcare-associated infection in mechanically ventilated patients. The incidence of VAP due to MDR pathogens has increased significantly in the last decade. Risk factors for VAP due to MDR organisms include advanced age, immunosuppression, broad-spectrum antibiotic exposure, increased severity of illness, previous hospitalization or residence in a chronic care facility and prolonged duration of invasive mechanical ventilation. Methicillin-resistant Staphylococcus aureus and several different species of Gram-negative bacteria can cause MDR VAP. Especially difficult Gram-negative bacteria include Pseudomonas aeruginosa, Acinetobacter baumannii, carbapenemase-producing Enterobacteraciae and extended-spectrum β-lactamase producing bacteria. Proper management includes selecting appropriate antibiotics, optimizing dosing and using timely de-escalation based on antibimicrobial sensitivity data. Evidence-based strategies to prevent VAP that incorporate multidisciplinary staff education and collaboration are essential to reduce the burden of this disease and associated healthcare costs (Grgurich et al., 2012).

Ventilator-associated pneumonia (VAP) is one of the most serious complications in mechanically ventilated patients that develops $48 hours after the patient has been placed on mechanical ventilation (MV). Pseudomonas aeruginosa is the most common isolate in late onset pneumonia, which developed beyond the fourth day of ventilation, and is associated with the worst morbidity and mortality rates. Many of the risk factors for colonization by P aeruginosa have also been recognized as predisposing conditions for nosocomial pneumonia, and colonization may precede this infection. Colonization should be viewed as the first step of an endogenous infection, but, in some out-breaks, contaminated devices, environment, and initially colonized patients may represent a potential exogenous source of infection to other patients (Hu et al., 2010).

2.2.7.2 Water quality and hand washing

Water quality refers to the characteristics of a water supply that will influence its suitability for a specific use. The water supply must be from a certified source, especially if hemodialysis is to be performed. Zone stop valves must be installed on

pipes entering each ICU to allow service to be turned off should line breaks occur (CDC, 2008).

When a toilet is included in a patient module, it should be equipped with bedpan cleaning equipment, including hot and cold water supplies and a spray head with foot control. In addition, when toilets are present, environmental control systems must be modified (Suzanne et al., 1995). Water supply capacity does not correspond with guidelines on basic human needs. Materials, equipment and external experts and technicians required for implementation and maintenance of safe water and sanitation projects are prohibited by the Israeli blockade; and "Governance issues between Gaza and Ramallah negatively affect necessary local ownership and exercise of duty-holder responsibilities, jeopardizing implementation and sustainability of water and sanitation projects" (UNICEF, 2011).

2.2.7.2.1 Water supply surveillance

1) Sanitary inspection depends on type of system (spring or piped water supply).

2) Water quality analysis

2.2.7.2.2 Microbiological aspects : "Bacteriological Indicators"

Ideally, drinking water should not contain any microorganisms known to be pathogenic. The primary bacterial indicator recommended for this purpose is the Coliform Group of organisms as a whole (Nguendo -Yongsi, 2011).

A- Coliform organisms:

The coliform group includes both fecal and non fecal. Most of coliforms are of fecal origin. There are several reasons why coliform organisms are chosen as indicators of fecal pollution:

1. They present in a huge amount in human intestine. It is considered as a foreign in potable water and hence their presence indicates evidence of fecal contamination.

2. Easily detected by culture methods as small as ONE bacteria in 100 ml of water

B. Fecal streptococci

They are regularly occur in feces but in much smaller in number than E. coli. If present in water, confirm the evidence of recent faecal contamination of water.

2.7.2.2.3 Hand washing

Hand hygiene is an important means of preventing nosocomial infections. Studies have shown a <50% compliance rate for hand hygiene among health care workers. A hand hygiene survey was administered to nursing students in a tertiary institution in Singapore. The results of this survey strongly indicate that nursing students understand the importance of hand hygiene compliance and perceive clinical internship programs and practical laboratory sessions to be effective methods of hand hygiene education. (Nasirudeen et al., 2012)

Compliance with specific hand hygiene practices is effective for preventing health care-associated infections, and the CDC 2002 guideline constitutes the current standard of care in the United States (Visscher et al., 2006). Antibacterial hand rubs are indicated

when visible soils are absent. Decontamination is to occur after contact with patient skin, fluids, equipment, and others. Health care institutions are to provide agents with low irritancy potential and products to minimize irritant dermatitis (Boyce and Pittet, 2002).

Frequent, repetitive exposure to hand cleansers can negatively impact the skin, particularly the protective stratum corneum (SC). The findings emphasize the importance of providing hand hygiene products to minimize irritant dermatitis and maintain an effective skin barrier. Use of such products is expected to substantially impact and increase hand hygiene compliance (Visscher et al., 2006).

There must be written policies and procedures for hand washing. Jewellery must be removed before washing. Simple hygiene procedures may be limited to hands and wrists; surgical procedures include the hand and forearm. Procedures will vary with the patient risk assessment (WHO, 2002).

Hand-washing sinks deep and wide enough to prevent splashing, preferably equipped with elbow-, knee-, foot-, or sonar-operated faucets, must be available near the entrances to patient modules, or between every two patients in ward-type units. This is a critical component of general infection control measures (Suzanne et al., 1995).

2.2.7.3 Environmental surfaces

The role of the inanimate environment in the transmission of nosocomial infections has been a subject of intense debate for decades. Prior to the 1970s, infection-control personnel routinely sampled hospital surfaces. It has been shown that bacterial contamination of hospital surfaces is common; floors and other surfaces in patient rooms, such as bed linens, bed rails, and tabletops, are almost universally contaminated by potentially pathogenic bacteria, such as *S. aureus*, *enterococci*, and Gram-negative bacilli such as *A. baumannii* (Christopher et al., 2005). However, studies are starting to show that the inanimate environment, while only rarely involved in the direct transmission of infection to patients, may well play an important indirect role in the nosocomial acquisition of pathogenic bacteria, contaminating health care workers' hands and equipment. The capacity of these organisms to persist for weeks to months on surfaces such as tabletops, bed railings, and linens raises concern about indirect horizontal transmission of pathogenic microorganisms (Christopher et al., 2005).

Many Gram-positive organisms, especially *Enterococci* and *S. aureus*, retain viability for periods in excess of three months when incorporated in dried organic materials commonly found on hospital surfaces (Neely et al., 2000). In contrast, Gram-negative organisms subsist for much shorter periods, in the order of hours, with the exception of *Klebsiella* species, *Acinetobacter* species, and *Enterobacter* species, which can retain viability for several days (Neely, 2000).

The capacity of surface organisms to secondarily contaminate health care worker's hands and clothes without any direct patient contact, provides support for the role of hospital surfaces in the horizontal spread of hospital pathogens. Moreover, a number of studies have shown that aggressive environmental disinfection with hypochlorite has been required to control epidemics caused by multiresistant bacteria (Ray et al., 2002).

2.2.7.4 Instruments and equipments

Movement of equipment between patients can also spread infection. Where dedicated equipment is not practical (e.g. portable X-ray machines, 12-lead ECG machines), nurses should encourage staff to ensure that any equipment touching patients is clean. Most equipment is used with the sickest, most susceptible, patients. One of the role of the housekeeping service is reviewing plans for renovations or new furniture, including special patient beds, to determine feasibility of cleaning (WHO, 2002).

An area must be provided for the storage and securing of large patient care equipment items not in active use. Space should be adequate enough to provide easy access, easy location of desired equipment, and easy retrieval. Grounded electrical outlets should be provided within the storage area in sufficient numbers to permit recharging of battery operated items (Suzanne et al., 1995).

2.2.7.4.1 Invasive procedures

Device-associated health care-acquired infections (DA-HAIs) in the intensive care unit (ICU) particularly central line-associated bloodstream infection (CLABSI), ventilator-associated pneumonia (VAP), and catheter-associated urinary tract infection (CAUTI) are known to pose a great threat to patient safety (Bijji et al., 2012).

Approximately 250,000 catheter-related bloodstream infections (CRBSIs) occurred in the United States in 2002. These preventable infections unnecessarily increase mortality and prolong hospitalization. This study provides national estimates of CRBSIs over 13 years (1996-2008) and identifies trends in mortality and hospital length of stay. Catheter-related bloodstream infections (CRBSIs) in US adults increased from 1996 to 2003 then declined until 2008. Patient mortality also declined throughout the study period, whereas hospital length of stay remained constant (Daniels & Christopher, 2012).

The adverse effects of DA-HAI attributable mortality, prolonged length of hospital stay (LOS), extra hospital costs, and increased bacterial resistance are more far-reaching in the developing world (Rosenthal, 2011). A report from the International Nosocomial Control Consortium (INICC) with data from 36 developing countries noted that although device use (DU) in ICUs in developing countries was similar to that reported for US ICUs at the Centers for Disease Control and Prevention's (CDC) National Healthcare Safety Network(NHSN), rates of DA-HAI were significantly higher in INICC hospitals (Rosenthal et al., 2011).

The burden of device-associated health care associated infection (DA- HAI) in China. This study examined the DA-HAI rate and evaluated its association with device use (DU), length of stay (LOS), and mortality in intensive care units (ICUs) in 4 Chinese hospitals In the study ICUs, VAP and CLABSI rates were higher than CDC/NHSN's reported data, and LOS and mortality were increased. Compared with the CDC/NHSN and INICC data, the pooled DU ratio for MV was similar, and DU ratios for CL and UC use ratios were slightly higher (Bijje et al., 2012).

Highly invasive equipment used with critically ill patients provides multiple entry sites for microorganisms so that benefits should be weighed against infection risks. Despite the fact that the use of devices in the developing countries' ICUs was remarkably similar to that reported in US ICUs in the CDC's NHSN, rates of device-associated

nosocomial infection were significantly higher in the ICUs of the INICC hospitals; the pooled rate of central line-associated bloodstream infection in the INICC ICUs of 6.8 per 1,000 central line-days was more than 3-fold higher than the 2.0 per 1,000 central line-days reported in comparable US ICUs. The overall rate of ventilator-associated pneumonia also was far higher (15.8 vs 3.3 per 1,000 ventilator-days), (Rosenthal et al. 2012).

According to statistics published by the Institute for Healthcare Improvement (IHI), 14,000 patient deaths occur each year as a result of bacteremias. The initial central line associated bloodstream infections (CLABSI) rate for our 32 bed Medical/Surgical ICU for the period of July 2004-June 2005 was 2.08 infections per 1,000 line days. An attempt at implementing the CDC recommended central line bundle without utilizing a check list tool resulted in a virtually identical infection rate of 2.05/1000 line days for the period of July 2005-June 2006. Following the implementation of the checklist and other bundle components in December 2006 the CLABSI has decreased to 0.58/1,000 line days. The ICU has not had a line infection since June 2007 which is equivalent to a total of 2,720 line days. By decreasing the number of central line associated bloodstream infections they were able to demonstrate a savings of $190,000 in one year (Henman et al., 2008).

2.2.7.5 Laundry

2.2.7.5.1 Linen and textiles management

The link between contaminated linens and infection in patients may be confused because the implicated organisms were often found in multiple environmental sources and on the hands of health-care workers. Efforts to reduce the occupational risk of infection associated with handling contaminated patient care and/or surgical textiles should primarily focus on the appropriate use of hand washing, protective barriers, and removal of foreign objects from the contaminated textiles. If standard precautions are followed, the chance of disease transmission is almost nonexistent. Infection among laundry worker are rarely reported, those reported are frequently related to the handling of soiled linen without proper barrier precautions. The contaminated textiles may become a source of patient infections, including *Staphylococcal, Bacillus cereus* colonization, and infection in newborns and antibiotic-resistant organisms in catheterized patients. Housekeeping activities such as shaking of linen out can aerosolize particles that may contain microorganisms, leads to air borne environmental contamination, so Contaminated textiles should be carefully removed with a minimum of agitation in order to minimize dispersion of microorganism into the air (folding or rolling technique) (Ling, 2011).

Contaminated textiles have been shown to be a source of large numbers of pathogenic organisms; however the risk of actual disease transmission is negligible. Clean and dirty utility rooms must be separate rooms that lack interconnection. They must be adequately temperature controlled, and the air supply from the dirty utility room must be exhausted. Floors should be covered with materials without seams to facilitate cleaning. The clean utility room should be used for the storage of all clean and sterile supplies, and may also be used for the storage of clean linen. Shelving and cabinets for storage must be located high enough off the floor to allow easy access to the floor underneath for cleaning (Suzanne et al., 1995).

Contaminated textiles and fabrics are placed into bags or other appropriate containment in this location; these bags are then securely tied or otherwise closed to prevent leakage. Single bags of sufficient tensile strength are adequate for containing laundry, but leak-resistant containment is needed if the laundry is wet and capable of soaking through a cloth bag (CDC, 2003)

Bags containing contaminated laundry must be clearly identified with labels, color-coding, or other methods so that health-care workers handle these items safely, regardless of whether the laundry is transported within the facility or destined for transport to an off-site laundry service (CDC, 2003). The dirty utility room must contain a clinical sink and a hopper both with hot and cold mixing faucets. Separate covered containers must be provided for soiled linen and waste materials. There should be designated mechanisms for the disposal of items contaminated by body substances and fluids. Special containers should be provided for the disposal of needles and other sharp objects. guidelines for intensive care unit design developed policies for the collection and trans-port of dirty linen, defining, where necessary, the method for disinfecting infected linen, either before it is taken to the laundry or in the laundry itself, developing policies for the protection of clean linen from contamination during transport from the laundry to the area of use (Suzanne et al., 1995).

2.2.7.5.2 Collection, bagging and transportation of soiled Lenin

Not shaking the items or handling them in any way that may aerosolize infectious agents. Avoiding contact of one's body and personal clothing with the soiled items being handled. Containing soiled items in a laundry bag or designated bin, no more than two third full, and not to stay in the unit more than 24 hours, both plastic and canvas bags are water resistant and can be used for the collection and transporting. Cloth bags can be washed and reused, are cheaper than the cost associated with single-use plastic bags and reduces the generation of disposable waste, there is no infection control advantage for double bagging unless the worker feels that the fluids cannot be contained by the primary bag (Ling, 2011).

2.2.7.5.3 Health care providers uniform

Uniforms are potential reservoirs for hospital organisms, potentially reinfecting the hands of health care workers (HCWs). The study aimed to determine the association between the bacterial contamination of HCWs' hands and uniforms (white coats and scrubs). HCWs working in 5 intensive care units had cultures obtained from their hands and uniforms (white coats or scrubs). The results was contamination of provider's hands with pathogens or *Acinetobacter baumannii* was associated with contamination of white coats. This association was not observed between hands and scrubs (Munoz-Price et al., 2012). Adequate laundry facilities should be provided for staff to change uniforms daily (Ronda, 2008).

Ideally clean uniforms should be worn each shift, and not worn outside the unit. Infected clothing is both a medium for growth and a means of transfer. Inadequate hospital laundry supply or turnover and limited changing facilities at work encourages staff to wash uniforms at home. Hospital laundry washes of 71°C kill most microorganisms (although not necessarily hepatitis B); while uniforms should withstand such temperatures, most casual clothing will not (Ronda, 2008).

ICUs using theatre-style 'pajamas suits' need adequate supplies to ensure all staff have clean uniforms each shift. Staff from other areas in direct contact with patients should be encouraged to either change into unit clothing, or remove jackets and coats worn outside the unit (before washing their hands) (Ronda, 2008).

2.2.7.6 Healthcare waste management

Palestinian Environmental Law (PEL) NO (7) 1999, was issued after approval of the Palestinian Legislative Council in its session on 6 / 7 /1999. These articles were motioned.

Article 10: "All agencies and individuals, in conducting any digging, construction; demolition, mining or transportation of debris and sands generated by such activities, shall commit themselves to take all necessary precautions for safe storage and transportation of such materials to prevent any environmental pollution", (PEL, 1999).

Article 12: "No person shall be authorized to manufacture, store, distribute, use; treat, or dispose any hazardous substance or waste whether it is solid, liquid, or gas, unless in accordance with the orders and directives specified by the Ministry in coordination with the competent agencies" (PEL, 1999)..

Article 23: "It is forbidden to dispose, treat or incinerate garbage and solid waste except in the sites designated for this purpose and in compliance with the conditions specified by the Ministry to ensure the protection of the environment" (PEL, 1999).

The housekeeping service is responsible for the regular and routine cleaning of all surfaces and main training a high level of hygiene in the facility. In collaboration with the Infection Control Committee it is responsible for:

1. Classifying the different hospital areas by varying need for cleaning
2. Developing policies for appropriate cleaning techniques developing policies for collection, transport and
3. Disposal of different types of waste (e.g. containers, frequency)
4. Dnsuring that liquid soap and paper towel dispensers are replenished regularly

There should be a continuing programme for staff training. This programme should stress personal hygiene, the importance of frequent and careful washing of hands, and cleaning methods (e.g. sequence of rooms, correct use of equipment, dilution of cleaning agents, etc.). Staff must also understand causes of contamination of premises, and how to limit this, including the method of action of disinfectants. Cleaning staff must know to contact staff health if they have a personal infection, especially infections of the skin, digestive tract and respiratory tract (WHO, 2002).

Arab Institute for Continuing Professional Development In collaboration with ESIC Control- in a special lecture about health care waste lectured by Dr. Faten Mostafa (2012) list that:

Healthcare Waste: 75% - 90 % of general waste (similar to domestic waste) 10% - 25% is hazardous (infectious, toxic, etc…) Within the scope of the infection control program, infectious medical waste is the only waste that poses an infection risk. Medical waste shall be considered capable of producing an infectious disease if:

- It has been contaminated by pathogen that can cause infection.

- If organism has a significant probability of being present in sufficient quantities and with sufficient virulence to transmit disease.
- Have a portal of entry to a susceptible host.

2.2.7.6.1 Steps for a Health Care Waste Management (HCWM) plan

1. Raise awareness of the problem, especially amongst policy makers.

2. Define a Policy (the rational for HCWM and what one wants to achieve).

3. Set up a Strategy (which is basically stating what steps must be taken to achieve the objectives that have been listed in the Policy).

4. Conduct an assessment of the current situation.

5. Draft a HCWM Plan that should contain a National Action Plan

6. Consolidate the legal & regulatory frameworks.

7. Standardize HCWM practices (edit National Guidelines).

8. Strengthen the institutional capacities (human and financial resources; training, etc.).

9. Set up waste management plans at all relevant levels.

10. Establish a monitoring plan.

The components of an "infectious waste" management plan include According to Association for Professionals in Infection Control (APIC, 2005): designation, segregation, packaging, storage, transport, treatment or disposal, contingency planning, and staff training.

2.2.7.6.2 Segregation and containerization

Designate waste as infectious or noninfectious at the point of generation of the waste. It is an initial and essential step for regulatory compliance, safety, and cost reduction. Training of all waste generators. To encourage segregation at source, (reusable) containers or baskets with liners of the correct size and thickness are placed as close to the point of generation as possible. They should be properly color-coded (yellow or red for infectious waste) and have the international infectious waste symbol clearly marked. When they are 3/4 full, the liners are closed with plastic cable ties or string and placed into larger containers at the intermediate storage areas. Suitable latex gloves must always be used when handling infectious waste. The waste should be placed into appropriate designated containers. Needles must never be recapped, bent, or removed before being discarded**.** Most errors in the medical waste management system occur at the segregation point and involve all associated occupational subgroups (WHO, 1999).

Healthcare Waste containers should be cleaned with a disinfectant solution at least once per day (Mostafa, 2011).

Environmental Protection Agency (EPA) recommended techniques for treatment of infectious wastes as steam sterilization, incineration, thermal inactivation, chemical disinfection, depending on the type of infectious waste. For example, Cultures and stocks of infectious agents and associated biologics could be treated with all previous

techniques. However, human blood and blood products could be treated only with sterilization, incineration, and chemical disinfection with exclusion for thermal inactivation (EPA, 2011).

2.2.7.7 Cleaning, disinfection and sterilization

The Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008, presents evidence based recommendations on the preferred methods for cleaning, disinfection and sterilization of patient-care medical devices and for cleaning and disinfecting the healthcare environment. This document supersedes the relevant sections contained in the 1985 Centers for Disease Control (CDC) Guideline for Hand washing and Environmental Control. Because maximum effectiveness from disinfection and sterilization results from first cleaning and removing organic and inorganic materials, this document also reviews cleaning methods (William et al., 2008).

2.2.7.7.1 Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes. Also, if soiled materials dry or bake onto the instruments, the removal process becomes more difficult and the disinfection or sterilization process less effective or ineffective. Surgical instruments should be presoaked or rinsed to prevent drying of blood and to soften or remove blood from the instruments (William et al., 2008).

2.2.7.7.2 Disinfectants are not interchangeable, and incorrect concentrations and inappropriate disinfectants can result in excessive costs. Because occupational diseases among cleaning personnel have been associated with use of several disinfectants (e.g., formaldehyde, Alcohol, and chlorine), precautions (e.g., gloves and proper ventilation) should be used to minimize exposure (Weber and Rutala, 1998). Asthma and reactive airway disease can occur in sensitized persons exposed to any airborne chemical, including germicides (William et al., 2008).

Although the effectiveness of high-level disinfection and sterilization mandates effective cleaning, no “real-time” tests exist that can be employed in a clinical setting to verify cleaning. If such tests were commercially available they could be used to ensure an adequate level of cleaning (Alfa et al., 1996). The only way to ensure adequate cleaning is to conduct a reprocessing verification test (e.g., microbiologic sampling) (Dancer, 2004).

2.2.7.7.3 Chlorine and Chlorine Compounds: Hypochlorite's, the most widely used of the chlorine disinfectants, are available as liquid (e.g., sodium hypochlorite) or solid (e.g., calcium hypochlorite). The most prevalent chlorine products in the United States are aqueous solutions of 5.25%–6.15% sodium hypochlorite, usually called household bleach. They have a broad spectrum of antimicrobial activity, do not leave toxic residues, are unaffected by water hardness, are inexpensive and fast acting (Rutala, 1997), remove dried or fixed organisms and biofilms from surfaces (Merritt et al., 2000), and have a low incidence of serious toxicity (Jakobsson et al., 1991). Moreover, a number of studies have shown that aggressive environmental disinfection with hypochlorite has been required to control epidemics caused by multiresistant bacteria (Ray et al., 2002).

On the other hand, sodium hypochlorite at the concentration used in household bleach (5.25-6.15%) can produce ocular irritation or oropharyngeal, esophageal, and gastric burns (Weber and Rutala, 1998). Other disadvantages of hypochlorites include corrosiveness to metals in high concentrations (>500 ppm), inactivation by organic matter, discoloring or "bleaching" of fabrics, release of toxic chlorine gas when mixed with ammonia or acid (e.g., household cleaning agents) (Mrvos et al., 1993).

2.2.7.7.4 Alcohol: In the healthcare setting, "alcohol" refers to two water-soluble chemical compounds - ethyl alcohol and isopropyl alcohol - that have generally underrated germicidal characteristics. FDA has not cleared any liquid chemical sterilant or high-level disinfectant with alcohol as the main active ingredient. These alcohols are rapidly bactericidal rather than bacteriostatic against vegetative forms of bacteria; they also are tuberculocidal, fungicidal, and virucidal but do not destroy bacterial spores. Their cidal activity drops sharply when diluted below 50% concentration, and the optimum bactericidal concentration is 60%–90% solutions in water (volume/volume) (William et al., 2008).

Although, Alcohols are not recommended for sterilizing medical and surgical materials principally because they lack sporicidal action and they cannot penetrate protein-rich materials. Fatal postoperative wound infections with Clostridium have occurred when alcohols were used to sterilize surgical instruments contaminated with bacterial spores (William et al., 2008).

Alcohols have been used effectively to disinfect oral and rectal thermometers (Sommermeyer, 1973), hospital pagers (Singh et al., 2002), scissors (Embil et al., 2002), and stethoscopes (Zachary et al., 2001). Alcohols have been used to disinfect fiberoptic endoscopes, but failure of this disinfectant have lead to infection (Langenberg et al., 1990). Alcohol towelettes have been used for years to disinfect small surfaces such as rubber stoppers of multiple-dose medication vials or vaccine bottles. Furthermore, alcohol occasionally is used to disinfect external surfaces of equipment (e.g., stethoscopes, ventilators, manual ventilation bags) (Weber et al., 1990), CPR manikins (Cavagnolo, 1985), ultrasound instruments (Ohara et al., 1998) or medication preparation areas. Two studies demonstrated the effectiveness of 70% isopropyl alcohol to disinfect reusable transducer heads in a controlled environment (Platt et al., 1988). In contrast, three bloodstream infection outbreaks have been described when alcohol was used to disinfect transducer heads in an intensive-care setting (McCarthy et al., 1999).

One of the difficulties associated with evaluating the bactericidal activity of disinfectants is prevention of bacteriostasis from disinfectant residues carried over into the subculture media. Likewise, small amounts of disinfectants on environmental surfaces can make an accurate bacterial count difficult to get when sampling of the health-care environment as part of an epidemiologic or research investigation. One way these problems may be overcome is by employing neutralizers that inactivate residual disinfectants (Johnston et al., 2002).

2.2.7.7.5 Ultraviolet radiation (UV)

The wavelength of UV radiation ranges from 328 nm to 210 nm (3280 A to 2100 A). Its maximum bactericidal effect occurs at 240–280 nm. Mercury vapor lamps emit more than 90% of their radiation at 253.7 nm, which is near the maximum microbicidal activity (Russell et al., 1999). Inactivation of microorganisms results from destruction

of nucleic acid through induction of thymine dimers. UV radiation has been employed in the disinfection of drinking water (Hall et al., 2003), air (Russell et al., 1999), titanium implants (Singh et al 1989), and contact lenses (Dolman et al., 1989). Bacteria and viruses are more easily killed by UV light than are bacterial spores (Russell et al., 1999). UV radiation has several potential applications, but unfortunately its germicidal effectiveness and use is influenced by organic matter; wavelength; type of suspension; temperature; type of microorganism; and UV intensity, which is affected by distance and dirty tubes (Shechmeister, 1991).

The application of UV radiation in the health-care environment (i.e., Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008 operating rooms, isolation rooms, and biologic safety cabinets) is limited to destruction of airborne organisms or inactivation of microorganisms on surfaces. The effect of UV radiation on postoperative wound infections was investigated in a double-blind, randomized study in five university medical centers. After following 14,854 patients over a 2-year period, the investigators reported the overall wound infection rate was unaffected by UV radiation, although postoperative infection in the "refined clean" surgical procedures decreased significantly (3.8%–2.9%) (Rutala et al., 1990).

2.8 Structural and managerial elements

2.8.1 Policies

These teams or individuals have a scientific and technical support role, E.g. Surveillance and research, developing and assessing policies and practical supervision, evaluation of material and products, the overseeing of sterilization and disinfection, ensuring the sound management of medical waste and the implementation of training programs. They should also support and participate in research and assessment programs at the national and international levels. The infection control team should consist of at least an infection control practitioner who should be trained for the purpose of carry out the surveillance program, develop and disseminate infection control policies, monitor and manage critical incidents and coordinate and conduct training activities (WHO, 2004).

Hygiene is helped by adequate and appropriate facilities and unit guidelines and protocols. All multidisciplinary team members should be actively involved in making decisions, but nurses have an especially valuable role in coordinating and controlling each patient's environment. Prevention can literally be 'life-saving'. Problems from infection are likely to escalate; continuing vigilance and care can minimize infection risks and the spread of microorganisms. The importance of nursing to infection control is emphasized through its inclusion in the Standards of Care for Critical Care Nursing (Ronda, 2008).

2.8.2 Vaccination

Healthcare workers (HCWs) can be exposed to infectious diseases and may transmit infections (e.g., influenza, pertussis, measles, mumps, rubella, varicella-zoster virus [VZV] infection, and hepatitis B virus [HBV] infection) in healthcare facilities. Vaccination reduces the risk to HCWs of acquiring a transmissible infectious disease and of transmission from HCWs to patients and to other HCWs (Sullivan et al., 2009).

Upon evaluation of effectiveness of an influenza control bundle to minimize healthcare-associated seasonal influenza. It was found that transmission among healthcare workers (HCWs) in an intensive care unit (ICU) equipped with central air conditioning, was associated with clinical and economic benefits to a Thai hospital (Apisarnthanarak et al., 2010).

Society for Healthcare Epidemiology of America (SHEA) views influenza vaccination of HCP as a core patient and HCP safety practice with which noncompliance should not be tolerated. It is the professional and ethical responsibility of HCP and the institutions within which they work to prevent the spread of infectious pathogens to their patients through evidence-based infection prevention practices, including influenza vaccination. Therefore, for the safety of both patients and HCP, SHEA endorses a policy in which annual influenza vaccination is a condition of both initial and continued HCP employment and/or professional privileges (Talbot et al., 2010). Despite decades of effort to encourage healthcare workers (HCWs) to be immunized, vaccination rates remain insufficient. Among German HCWs, 831 (68.4%) of 1,215 respondents supported mandatory vaccinations for HCWs in general. However, acceptance of mandatory vaccination varied significantly between physicians and nurses and also depended on the targeted disease (Wicker et al,. 2010).

The results of Wicker et al, (2010) are in line with those of a recently published study of a children's hospital in Kansas City, Missouri, in which most of the HCWs (70%) thought influenza vaccination should be mandatory for HCWs. Their analysis of the professional groups revealed that physicians and nurses have different attitudes and perceptions. Nurses had lower vaccination rates, were more likely to reject mandatory vaccinations, and were less likely to be convinced that vaccinations are important for them. With the exception of HBV vaccination, this result was found for all vaccinations investigated (influenza, MMR, VZV, and pertussis) This result could reflect a higher awareness among physicians regarding the benefits of vaccinations either for patients or for themselves. However, nurses usually have both closer and longer contact with patients than any other professional group of HCWs (Wicker et al,. 2010).

2.8.3 Education and training

The prevention of HAIs requires an organized education and training program regarding proper IPC procedures in the health care setting, aimed at health care providers, clients/patients/residents and their caregivers. A coordinated, effective educational program will result in improved IPC activities. Education programs should be flexible enough to meet the diverse needs of the range of HCPs and other staff who work in the health care setting. The local public health unit and regional Infection Control Networks may be a resource and can provide assistance in developing and providing education programs for all health care settings. IPC education should be provided to all staff, especially those providing direct client/patient/resident care, at the initiation of employment as part of their orientation and as ongoing continuing education (Ontario Ministry of Health and Long-Term Care, 2011).

Hand hygiene is an important means of preventing nosocomial infections. Studies have shown a <50% compliance rate for hand hygiene among health care workers. A hand hygiene survey was administered to nursing students in a tertiary institution in Singapore. The results of this survey strongly indicate that nursing students understand the importance of hand hygiene compliance and perceive clinical internship programs

and practical laboratory sessions to be effective methods of hand hygiene education (Nasirudeen et al., 2012).

Training and education is an important function of any organization as a method to develop the human resource and enrich their experience and knowledge. It directly affects the IPC practice and performance and hence the improvement of healthcare services and outcome. Training is an organized activity aimed at imparting information and/or instructions to improve recipient's performance or to help him to attain a required level of knowledge or skill (Business Dictionary, 2011). Education and training in teamwork and communication skills is essential to creating an ICU culture that values learning, improvement, and accountability. Several resources and tools to assist with training and education have been provided in this guide and on the accompanying CD-ROM. To fuel the momentum for ongoing improvement efforts, the facility should give staff continuous feedback on "how we are doing" with regard to providing safer critical care (ECRI, 2007).

2.8.4 Environmental monitoring

Microbiologic sampling of air, water, and inanimate surfaces (i.e., environmental sampling) is an expensive and time-consuming process that is complicated by many variables in protocol, analysis, and interpretation. It is therefore indicated for only four situations (CDC, 2004):

• The first is to support an investigation of an outbreak of disease or infections when environmental reservoirs or fomites are implicated epidemiologically in disease transmission. It is important that such culturing be supported by epidemiologic data. Environmental sampling, as with all laboratory testing, should not be conducted if there is no plan for interpreting and acting on the results obtained. Linking microorganisms from environmental samples with clinical isolates by molecular epidemiology is crucial whenever it is possible to do so (Sehulster et al., 2004).

• The second situation for which environmental sampling may be warranted is in research. Well-designed and controlled experimental methods and approaches can provide new information about the spread of health-care–associated diseases. A classic example is the study of environmental microbial contamination that compared health-care–associated infection rates in an old hospital and a new facility before and shortly after occupancy (CDC, 2004).

• The third indication for sampling is to monitor a potentially hazardous environmental condition, confirm the presence of a hazardous chemical or biological agent, and validate the successful abatement of the hazard. This type of sampling can be used to:a) detect bio-aerosols released from the operation of health-care equipment and determine the success of repairs in containing the hazard) detect the release of an agent of bioterrorism in an indoor environmental setting and determine its successful removal or inactivation, and c) sample for industrial hygiene or safety purposes (e.g., monitoring a "sick building") (Sehulster et al., 2004).

• The fourth indication is for quality assurance to evaluate the effects of a change in infection-control practice or to ensure that equipment or systems perform according to specifications and expected outcomes. Any sampling for quality-assurance purposes must follow sound sampling protocols and address confounding factors through the use

of properly selected controls. Results from a single environmental sample are difficult to interpret in the absence of a frame of reference or perspective. Evaluations of a change in infection-control practice are based on the assumption that the effect will be measured over a finite period, usually of short duration. Conducting quality-assurance sampling on an extended basis, especially in the absence of an adverse outcome, is usually unjustified. A possible exception might be the use of air sampling during major construction periods to qualitatively detect breaks in environmental infection-control measures (Sehulster et al., 2004).

The clinical microbiology laboratory contributes to preventing transmission of infectious diseases in healthcare settings by promptly detecting and reporting epidemiologically important organisms, identifying emerging patterns of antimicrobial resistance, and assisting in assessment of the effectiveness of recommended precautions to limit transmission during outbreaks, outbreaks of infections may be recognized first by laboratorians (Siegel et al., 2007).

Today, however, the work done by the microbiology laboratory is increasingly complex and demanding. Much of this has direct implications on hospital epidemiology and infection control. Microbiology laboratories now must be able to detect, identify, and characterize an expanded array of microbes, including newly emerging pathogens (Stratton and Greene, 2004).

2.8.4.1 Auditing and supervision

As managerial responsibility the health care facility must have a supervision monitoring, and evaluation activities to direct the employee to do the things right. Continuous monitoring and evaluation will encourage the best practice and service. Every health facility should have infection control team as a supervision body; the infection control team is responsible for the day-to-day activities of the infection control program. Health care establishments must have access to specialists in infection control, including physicians and infection control practitioners (WHO, 2004).

In some countries, these professionals are specialized teams working for a hospital or a group of health care establishments; they may be administratively part of another unit (e.g. a microbiology laboratory, medical or nursing administration, public health services). The optimal structure will vary with the type, needs, and resources of the facility (WHO, 2004).

The reporting structure must, however, ensure the infection control team has appropriate authority to manage an effective infection control program. In large facilities, this will usually mean a direct reporting relationship with senior administration. The infection control team or individual is responsible for the day-to-day functions of infection control, as well as preparing the yearly work plan for review by the infection control committee and administration (WHO, 2004).

2.8.4.2 Surveillance

Pathogen prevalence surveillance combined with daily review of culture reports is effective to identify an outbreak in a timely manner and optimizes the ability to intervene. Immediately sharing the molecular nstudy results and timeline of patient stays with the ICU staff helped them understand the outbreak and accept responsibility

for infection prevention. Improved adherence to hand hygiene and isolation techniques resolved this outbreak (Myer et al., 2005).

Surveillance of HAIs provides data useful for identifying infected patients, determining the site of infection, and identifying the factors that contribute to HAIs. When infection problems are recognized, surveillance data allow the hospital to institute appropriate intervention measures and evaluate their efficacy. In addition, one can follow the trends of infections that are increasing in incidence, such as bloodstream infections (Horan and Gaynes, 2004).

Where resources are limited, the use of surveillance as an infection monitoring tool generally should be restricted to investigating outbreaks or exposures. When considering initiating other types of surveillance activities, the objectives should be reasonable in terms of the resources and time available, and the projected use for the data should be clearly defined before routine collection of data is established (Tietjen et al., 2003).

2.8.5 Availability of resources

Hsia et al, (2011) in their research about the access to emergency and surgical care in sub-Saharan Africa found that the percentage of hospitals with dependable running water and electricity ranged from 22% to 46%. In countries analyzed, only 19–50% of hospitals had the ability to provide 24-hour emergency care. For storage of medication, only 18% to 41% of facilities had unexpired drugs and current inventories. Availability of supplies to control infection and safely dispose of hazardous waste was generally poor (less than 50%) across all facilities. As few as 14% of hospitals (and as high as 76%) among those surveyed had training and supervision in place. Availability of infection prevention materials has been cited as important determinants of compliance.

Availability of infection prevention materials has been cited as important determinants of compliance. Another study reported that inadequate supply of gloves in southern province based health facilities lead to incorrect routines; for example, the average number of vaginal examinations for each woman at the University Teaching Hospital where supply of gloves was adequate was 3.5 compared to 2 in Southern Province based health facilities. In another study conducted it was reported that general hygienic measures taken in hospitals to reduce the risk of HIV infection were insufficient and that many inadequacies stemmed from lack of supplies (Katowa et al, 2007).

2.8.6 Barriers overcome

Gradually, evidence is accumulating that links work environments to behavior, attitudes, and motivations among clinicians. These behaviors and orientations can, in turn, affect quality processes and outcomes. A growing number of studies in health care show that members of organizations are more satisfied when they work in climates that have more supportive and empowering leadership and organizational arrangements, along with more positive group environments (often reflecting elements of group support and collaboration). Moreover, although the research base is not as strong, there is emerging evidence that these same organizational attributes impact employee turnover and, most important, patient safety. Improving the organizational climate is likely to improve patient safety and decrease overall health care costs. However, future research studying specific interventions and their cost effectiveness is needed (Patricia et al., 2009)

2.9 Individual factors

2.9.1 Knowledge and Attitudes of HCPs

Gaps between knowledge and actual clinical practice have not been sufficiently analyzed. We assessed knowledge of and compliance with guidelines for prevention of VAP among physicians, nurses, and students in adult intensive care units (ICUs). All adult ICU health care workers (HCW) were invited to complete a 20-point questionnaire. The first part assessed personal knowledge of international guidelines for prevention of VAP; the second part assessed daily clinical practice. Personal knowledge and daily practice were scored from 0 to 10 points. We invited 257 ICU-HCWs to participate in the study, and 167 (65%) accepted (32/54 physicians, 108/176 nurses, and 27/27 students). The median (IQR) personal knowledge scores for physicians, nurses, and students were 6 (5-7), 5 (4-6), and 5 (4-7). The median scores for daily clinical practice for physicians and nurses were 5 (4-6) and 4 (3-5), respectively. HCWs with more than 1 year of ICU experience scored significantly better in personal knowledge than those with less experience: 6 (5-7) vs 4 (3-6); p=0.004. Finally, a simple, easy-to-complete questionnaire enabled us to rapidly evaluate personal knowledge and reported clinical practice in prevention of VAP in large teaching institutions. These scores will be used as baseline figures to assess the impact of educational and intervention campaigns (Pérez-Granda et al., 2012).

Many researchers conducted this factor and revealed the relations between the knowledge and attitude and the IPC protocol. In a study conducted at Nigeria about the awareness, knowledge, attitude and practice of blood and body fluid precautions among radiographers the study explores the awareness, knowledge, attitude and practice of universal precautions among radiographers as well as their sensitivity towards the possibility of being occupationally exposed and extent of their exposure to infections. A total of 24 radiographers were assessed. The index used to assess the awareness was how they knew about universal blood and body fluid precautions. 20.8% (n= 5) of radiographers knew about universal precautions through books, 8.4% (n=2) knew through someone, 58.3% (n=14) through seminar/ symposium, while 12.5% (n=3) knew through mass media. Only 37.5% (n=9) was against recapping of needles and 29.2% (n=7) rated their knowledge very good. 45.8% (n=11) of the radiographers have received occupational training on Ups. The attitude radiographers towards patients with blood and body fluid-borne pathogens were positive. No radiographer was identified to have been occupationally infected (Okaro et al., 2010).

Another study was conducted in Iran to assess the level of knowledge, attitude, and practice among Iranian dental healthcare professionals towards standard isolation precautions in Shiraz, Iran. Practice of standard isolation precautions was poor among dental professionals in Shiraz University of Medical Sciences. This study showed that knowledge of infection control measures and a positive attitude towards them alone do not have an impact on adherence to recommendations (Askarian, 2009).

In Egypt, a study conducted at the endoscopy units in El-Kasr El-Ani Hospital, to assess the knowledge of health team in relation to infection control measures as well as their 26 level of practice in the application of infection control measures. The study results revealed that 5% of physicians and 10% of nurses had satisfactory knowledge, and 30% of physicians and just 4% of nurses had adequate level of performance, while

none of the workers had satisfactory level of knowledge or practice. The study recommended an educational program for the endoscopy staff about infection and infection control measures application for the protection of staff and patients. The researcher found that the factor affecting infection control measures in endoscopy department regarding endoscopy health team level of knowledge and practice is the lack of knowledge in addition to insufficient level of performance during and post procedure as disinfection of endoscope, hand washing, and cleaning of environment post procedure, and few written Arabic protocols for universal precautions (El Shamaa, 2010).

2.10 HCPs Practices commitment to EIC guidelines.

We assessed knowledge of and compliance with guidelines for prevention of VAP among physicians, nurses, and students in adult intensive care units (ICUs). The median scores for daily clinical practice for physicians and nurses were 5 (4-6) and 4 (3-5), respectively (Pérez-Granda et al., 2012). Minimizing movement of staff between patients also reduces risks. While nurses need help for many aspects of care, the one-to one nurse/patient ratio of most ICUs helps to limit the movement of nurses; other staff groups necessarily need to move between patients, especially sicker patients, so that nurses should discourage any unnecessary (Lin, 2011).

Compliance is the extent to which certain behavior (for example, following physician's orders or implementing healthier lifestyles) is in accordance with the physicians‟ instructions or health care advice. Compliance can be influenced or controlled by a variety of factors like culture, economic and social factors, self-efficacy, and lack of knowledge or means. Guidelines that guide an individual's behavior exist in a variety of settings (including health care settings), but people do not always comply with them. (Efstathiou et al, 2011).

Yassi et al. (2007) conducted a study about determinants of HCWs‟ compliance with infection control procedures; the purpose of this study was to assess determinants of HCWs self-reported compliance with infection control procedures. A survey was conducted of HCWs in 16 healthcare facilities. A strong correlation was found between both environmental and organizational factors and self-reported compliance. No relationship was found with individual factors. Another factor that has been associated with compliance is incorporation of IPC Guidelines in the HCWs‟ curricular and in-service training on IP protocols (Katowa et al., 2007).

Chapter III

Methodology

This chapter presents study methodology which include the study design, period of study, place of study, study population, study sampling and ethical consideration. As well, materials and methods of environmental samples and measurements, microbiological samples and measurements description and processing. Furthermore, selection criteria, study instrument, piloting, response rate, data collection and analysis process and finally the limitation of the study.

3.1 Study design

The design of this study is descriptive analytical cross sectional design, consists of a checklist to evaluate environmental fitness of the intensive care units in Gaza governorates. In addition, a questionnaire was developed to evaluate the healthcare providers knowledge and attitude towards EIC. Moreover, another observational checklist was developed to evaluate HCPs practices.

3.2 Period of study

The study was conducted from January 2012 to February 2013, it was started by preparing research proposal, then get the approval from the University to start the study in April 2012, the approval from Ministry of Health (MOH) to start data collection, designing the data collection instruments, after pilot study, data collected from October to December 2012 and then data analysis and writing in January and February.

3.3 Place of study

The study carried out in the two main locations in which MOH has general ICUs which provide intensive care for most specialties at Gaza hospitals, includes two health centers Shifa complex and European Gaza Hospital (EGH).

3.4 Study population

The population of the study consisted of all HCPs (physicians, nurses and physiotherapists) who are meeting the eligibility criteria, and the intensive care units in the two selected hospitals. So census population was used to answer the questionnaire and to be observed for their practice.

The total number of the HCPs at the ICUs was 81 persons, distributed as 31 physicians, 44 nurses and 6 physiotherapists.

However, all of them were observed to fulfill the observation checklist concerning answering the questionnaire. The total number of the observed HCPs was 68 persons (physicians and nurses) who are meeting the eligibility criteria.

Therefore, nurses and physiotherapist that didn't work fulltime duties were excluded. The checklist were filled three times for everyone of the HCPs in different shifts to obtain 204 filled checklist, which reflect the actual practice of all HCPs.

3.5 Eligibility

3.5.1 Inclusion criteria

Two general ICUs in Gaza governorates will be eligible for selection in this study.

1. The first is Shifa complex
2. The second is EGH

On the other hand, all HCPs who are classified as governmental employee with experience more than three months in the two units were included in the study, HCPs as:

1. Nurses.
2. Physicians.
3. Physiotherapists working in the units.

3.5.2 Exclusion Criteria

1. The hospitals that haven't general ICU which don't provide intensive care for most specialties.
2. The ICUs which provide intensive care for one specialty as cardiac units, cardiac surgery units and neonatal units.
3. For questionnaire: HCPs with experience less than three months.
4. For practice observation checklist: not resident physiotherapist because their spending time in ICU is almost not enough to be observed and evaluated.
5. For practice observation checklist: not resident nurses who are working in the cardiac surgery intensive care because they are not almost present during the researcher observing time.

3.6 Response rate

a. Questionnaire:

Of the 81 HCPs who constitute the study population 73 responded with a response rate of 90.1 %.

b. Observation checklist

All of the 68 HCPs who constitute the study population was observed with a rate of 100 %. Thus, nurses who work in the cardiac surgery intensive care were excluded because they were not almost present during the researcher observing time.

3.7 Ethical considerations

The researcher was committed to all ethical consideration required to conduct a research. Ethical approval was obtained from Helsinki committee in Gaza (Annex 4) Also an official approval was obtained from the Ministry of Health-Gaza, by the General Directorate of Human Resource Department (Annex 2), then General Hospitals Administrator and finally hospitals directors.

Every participant in the study received a complete explanation about the research purposes and confidentiality. Every person in the study population informed about the optional participation in the study. All the ethical consideration observed, respect for people and human rights and respect for truth. Confidentiality was given and maintained.

3.8 Study instrument

The researcher developed his own tools to evaluate environmental infection control in the major ICUs. The tools consisted of two checklist and one questionnaire, which all had been constructed based on the Palestinian IPC protocol and international guidelines of the World Health Organization (WHO) and communicable disease center (CDC) for environmental infection control.

3.8.1 The fitness checklist for the unit environment:

The first observation checklist (fitness checklist) to evaluate environmental infection control measures in intensive care units containing seven domains which are air and ventilation system quality, water quality, environmental surfaces, , laundry, healthcare waste management, instruments and equipment, and cleaning aids "antiseptic disinfection and sterilization".
This instrument have two uses, the first one is to evaluate existing environmental infection control measures by routine wake around checking, in order to be provided to the infection control committee in MOH hospitals as an evaluation tool (wake around checklist).
The second one used to serve the research need, by adding environmental sampling, microbiological sampling of (air, water, and inanimate surfaces) and two environmental measurements as temperature and relative humidity to evaluate air quality.

3.8.2 The observation checklist for the health care providers:

The second observation checklist was evaluating HCPs practices in ICUs at Gaza Governorates toward EIC. The observations of the HCPs covered eight categories which are keeping air quality at the unit environment, wearing uniform, hand washing practices, personal protective equipment (PPE) and use of gloves, handle laundry linens in proper way, dealing with instruments and equipments of (patient airway management, central venous catheter(CVC), peripheral venous catheter (PVC), IV fluids and medication, Folly's catheter), the last two categories are use of antiseptics and disinfectant solutions and finally discarding medical waste and sharp disposal properly.

3.8.3 Self-administered questionnaire:

The questionnaire was used to assess knowledge, attitude and of HCPs in ICUs at Gaza Governorates toward EIC. It consisted of five sections. The first part covered personal and professional information, the second part contains questions that assess HCPs knowledge about policies, education, frequencies of vaccination, diseases and injures. The third part contains questions to assess HCPs knowledge about EIC, and the fourth one covered HCPs attitude toward EIC. The last part identify barriers that decrease HCPs compliance with EIC guidelines.

The questionnaire had been distributed after being translated to Arabic language to be easily understood by the respondents. In each questionnaire, an explanatory letter was

attached to facilitate questionnaire filling. The questionnaire was clear with no complex terms, no jargons, and no leading questions. All questions follows likart scale or binary scale as the following:

Table 3.1: likart scale or binary scale

Level	Strongly agree	Agree	Don't know	Disagree	Strongly disagree
Scale	5	4	3	2	1
Level	**Yes**	**No**			
Scale	1	0			

Table 3.2: Field of the study and their measurement instruments

No	Study Domains	Measurement Instruments
1	Environmental safety measures	Observation checklist and environmental sampling
2	Individual practices	Observation checklist
3	Individual factors	Questionnaire (Self-administered)
4	Structural and managerial elements	Questionnaire (Self-administered)

Table 3.3: Common Domains of the study

No	Study Domains
1	Air & ventilation system
2	Water quality and hand washing
3	Environmental surfaces
4	Instruments and Equipments
5	Suctioning of sputum secretion
6	Laundry
7	Mattresses and Pillows
8	Healthcare waste and Sharp disposal
9	Cleaning aids "disinfection and sterilization"
10	Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines

3.9 Reliability

Reliability of an instrument is the degree of consistency with which it measures the attribute it is supposed to be measuring . The test is repeated to the same sample of people on two occasions and then compares the scores obtained by computing a reliability coefficient. For the most purposes reliability coefficient above 0.7 are considered satisfactory. Period of two weeks to a month is recommended between two tests. Due to complicated conditions that the contractors is facing at the time being, it was too difficult to ask them to responds to our questionnaire twice within short period. The statistician's explained that, overcoming the distribution of the questionnaire twice to measure the reliability can be achieved by using Cronbach's Alpha coefficient and Split half Method through the SPSS software**.**

1. Split half Method

This method depends on finding Pearson correlation coefficient between the means of odd rank questions and even rank questions of each field of the questionnaire. Then, correcting the Pearson correlation coefficients can be done by using Spearman Brown correlation coefficient of correction. The corrected correlation coefficient (consistency coefficient) is computed according to the following equation :

Consistency coefficient = 2r/(r+1), where r is the Pearson correlation coefficient. The normal range of corrected correlation coefficient 2r/(r+1) is between 0.0 and + 1.0 As shown in Table 3.4, all the corrected correlation coefficients values are between 0.8182and 0.8966 and the general reliability for all items equal 0.8552, and the significant (α) is less than 0.05 so all the corrected correlation coefficients are significance at α = 0.05. It can be said that according to the Half Split method, the dispute causes group are reliable.

Table 3. 4: Split-Half Coefficient method

No.	Section	Person-correlation	Spearman-Brown Coefficient	Sig. (2-(Tailed
1	Air & ventilation system	0.8125	0.8966	**0.000**
2	Water quality and hand washing	0.7255	0.8409	**0.000**
3	Environmental surfaces	0.7725	0.8717	**0.000**
4	Instruments and Equipments	0.7125	0.8321	**0.000**
5	Suctioning of sputum secretion	0.6995	0.8232	**0.000**
6	Laundry	0.7525	0.8588	**0.000**
7	Mattresses and Pillows	0.7525	0.8588	**0.000**
8	Healthcare waste and Sharp disposal	0.6924	0.8182	**0.000**
9	Cleaning aids "disinfection and sterilization	0.7895	0.8824	**0.000**
10	Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines	0.7954	0.8860	**0.000**
	All items	**0.7470**	**0.8552**	**0.000**

2. Cronbach's Coefficient Alpha

This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach's coefficient alpha value between 0.0 and + 1.0, and the higher values reflects a higher degree of internal consistency. As shown in Table 3.5 the Cronbach's coefficient alpha was calculated for the first field of the causes of claims, the second field of common procedures and the third field of the Particular claims. The results were in the range from 0.8391and 0.9215, and the general reliability for all items equal 0.8991. This range is considered high; the result ensures the reliability of the questionnaire.

Table 3.5: Cronbach's Alpha for Reliability

No.	Items	Cronbach's Alpha
1	Air & ventilation system	**0.9215**
2	Water quality and hand washing	**0.8719**
3	Environmental surfaces	**0.9014**
4	Instruments and Equipments	**0.8625**
5	Suctioning of sputum secretion	**0.8425**
6	Laundry	**0.8759**
7	Mattresses and Pillows	**0.8896**
8	Healthcare waste and Sharp disposal	**0.8391**
9	Cleaning aids "disinfection and sterilization	**0.9157**
10	Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines	**0.8765**
	All items	**0.8991**

3.10 Validity

3.10.1 Face validity

It is achieved by organizing the three instruments in categories with logical sequence.

3.10.2 Content validity

The three instruments were sent to a panel of expert persons (annex 10) to assess the clarity and relevance of the questionnaire to the objectives of the study. All comments on the instruments were taken in consideration, as a result some modification for some items were done. In addition a pilot study was conducted before starting the data collection of the questionnaire .

Criterion related validity :

1. **Internal consistency**:

Internal consistency of the questionnaire is measured by a scouting sample, which consisted of **thirty** questionnaires, through measuring the correlation coefficients between each paragraph in one field and the whole filed. Tables below shows the correlation coefficient and p-value for each field items. As show in the tables the p-Values are less than 0.05 or 0.01, so the correlation coefficients of this field are significant at $\alpha = 0.01$ or $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for.

The correlation coefficient between each paragraph in the field and the whole field:-

Table 3.6: Air & ventilation system

No.	Items	Pearson coefficient	p-value
71	Windows and doors should kept closed as much as possible.	0.613	0.000
72	The standards of air ventilation system for infection control in your unit is met (minimum total air change is at least six air exchanges per hour ACH).	0.552	0.002
73	Temperature level average in your unit is satisfactory	0.508	0.004
74	Your provided care is affected negatively by unsatisfactory temperature level average in your unit	0.630	0.000

Table 3.7: Water quality and hand washing

No.	Items	Pearson coefficient	p-value
75	Hand washing is not the most proper way for infection control.	0.705	0.000
76	Available water is high quality (no visible pollution indicator as verdigris or deposited materials)	0.674	0.000
77	Hand rub need to be alternative of hand washing	0.768	0.000

Table 3.8: Environmental surfaces

No.	Items	Pearson coefficient	p-value
78	The floor should be covered with ceramic.	0.621	0.000
79	Glove use for all patients is a useful strategy for reducing risk of surgical site infection.	0.704	0.000
80	Sterile items will not be affected from dust, moisture, insects and extremes of temperature and humidity in storage rooms.	0.775	0.000

Table 3.9: Instruments and Equipments

No.	Items	Pearson coefficient	p-value
81	Monitors, ventilator, infusion pumps, syringe pumps and prepared suction bottles should be clean, free from dust & disinfected daily & between patients by nurse.	0.765	0.000
82	Monitors cables should be clean, free from dust & disinfected daily & between patients by nurse.	0.681	0.000
83	Bed frames should be clean, free from dust and disinfected daily & between patients by nurse .	0.671	0.000

Table 3.10: Suctioning of sputum secretion

No.	Items	Pearson coefficient	p-value
84	Suction catheter should be attached after doing suction to be ready for second suction .	0.733	0.000
85	Suction bottle are disinfected in satisfactory manner for reuse	0.702	0.000
86	Sterile water should be use for suction tubes irrigation post each suctioning procedure	0.588	0.001
87	Irrigation container should be disposable	0.647	0.000

Table 3.11: Laundry (linen)

No.	Items	Pearson coefficient	p-value
88	Soiled linen should be disposed in a water-soluble bag then double plastic bagged.	0.648	0.000
89	Soiled linens should be labeled	0.411	0.024

Table 3.12: Laundry (Mattresses and Pillows)

No.	Items	Pearson coefficient	p-value
90	Mattress and pillow covers should not be replace if they become torn or otherwise in need of repair.	0.419	0.021
91	Mattresses should kept dry & should be discard if they become and remain wet or stained.	0.414	0.023
92	Correct segregation of waste: domestic, infectious, and cytotoxic should done	0.765	0.000

Table 3.13: Sharp disposal

No.	Items	Pearson coefficient	p-value
93	Used needles should not be removed from syringes before disposal.	0.588	0.001
94	Used needles should not be recapping prior disposal.	0.647	0.000

Table 3.14: Cleaning aids "disinfection and sterilization".

No.	Items	Pearson coefficient	p-value
95	Instruments are brushed well before soaked in disinfectant.	0.414	0.023
96	Instruments are not need to allowed to dry before sterilization.	0.765	0.000
97	The laryngoscope and anesthesia instrument should be cleaned with disinfectant solution after each use	0.704	0.000

Table 3.15: Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines.

No.	Items	Pearson coefficient	p-value
98	Unsuitable design and infrastructure of the ICU to environmental infection control (EIC) .	0.588	0.001
99	Lack of materials and equipment regarding EIC.	0.647	0.000
100	Lack of knowledge and education regarding EIC	0.464	0.020
101	Insufficient training regarding EIC.	0.575	0.000
102	Difficult to understand in spite of lectures and training.	0.433	0.031
103	Employee dissatisfaction.	0.607	0.001
104	Lack of time and work overload.	0.571	0.003
105	The shortage of human resource.	0.616	0.001
106	Unavailability of aid nurse	0.488	0.013
107	Lack of supportive policy & auditing programs .	0.517	0.008
108	No accountability and feedback from administration.	0.540	0.005
109	Lack of guidelines from colleague and superior.	0.693	0.000

2.Structure Validity of the Questionnaire

Structure validity is the second statistical test that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of likert scale. As shown in table 3.16 the significance values are less than 0.05 or 0.01, so the correlation coefficients of all the fields are significant at $\alpha = 0.01$ or $\alpha = 0.05$, so it can be said that the fields are valid to be measured what it was set for to achieve the main aim of the study.

Table 3.16: Structure Validity of the Questionnaire

No.	Section	**Pearson** correlation coefficient	p-value
1	Air & ventilation system	0.899	**0.000**
2	Water quality and hand washing	0.932	**0.000**
3	Environmental surfaces	0.908	**0.000**
4	Instruments and Equipments	0.891	**0.000**
5	Suctioning of sputum secretion	0.842	**0.000**
6	Laundry	0.799	**0.000**
7	Mattresses and Pillows	0.892	**0.000**
8	Healthcare waste and Sharp disposal	0.665	**0.000**
9	Cleaning aids "disinfection and sterilization	0.734	**0.000**
10	Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines	0.732	0.000

3.11 Pilot Study:

A pilot study was conducted before starting the data collection as a pretest to point out weaknesses in wording, translation to Arabic, predict response rate, determine the real time needed to fill the questionnaire and identify areas of vagueness and to test the validity and suitability of the questionnaire.

A total of 30 participants were chosen from the study target population to conduct the pilot study. However, at the end of this process one small change have been conducted

which is: mode of answering knowledge related questions from five scale to three scale. Because this modification didn't affect its important content of the questionnaire and didn't make a significant change, the researcher decided to include the pilot study in the total data. On the other hand, the population sample was not big enough to exclude more participant from the study sample, thus it is a census study.

3.12 Data collection

The data was collected through the two observational checklist and the questionnaire during the period of three months for the two observational checklist crossing two months for the questionnaire, the months respectively were October, November and December 2012.

The first observational checklist "fitness checklist" was filled by the researcher himself, each one item observed three times to differentiate between habitual and occasionally conditions.

The second observational checklist for HCPs practices, the checklist were filled three times to reflect the actual practices of HCPs. And so, 68 HCPs, 38 nurses and 30 physicians were observed to obtain 204 filled checklist, in a total of 16524 observations for different practices.

However, The researcher distribute the questionnaire to HCPs and receive it in the same shift in the two ICUs. The action was repeated three days in different shifts each week in Shifa ICU for eight continuous weeks, and one day a week in different shifts at the same weeks period in EGH ICU.

During the researcher stay in both units, observational checklists were filled. Although, all measurement and microbiological environmental sampling were done in that period.

3.13 Data management and statistical analysis

Data analysis was conducted using (SPSS 19), and Microsoft excel. The data was gathered and then the instruments reviewed, coding the data, appropriate entry method, coding variables, data cleaning then doing frequencies and cross tabulation. An independent t-test and one way ANOVA statistical test were used to investigate the relationship between the independent and dependent variables.

The personal characteristics (gender, age, marital status, profession, last degree awarded, current job position and years of experience) as independent variables and other variables as structural and managerial factors, knowledge, attitude, and barriers that decrease HCPs commitment to environmental infection control as dependent variable.

Statistical methods are as follows:

1- Frequencies and Percentile

2- Alpha- Cronbach Test for measuring reliability of the items of the questionnaires.

3- Person correlation coefficients for measuring validity of the items of the questionnaires.

4- Spearman –Brown Coefficient.

3.14 Materials and Methods of Environmental Samples and Measurements

Table 3.17: Apparatus

Auto ranging multimeter	MASTECH(MS8209)
Air sampler	AES CHEMUNEX, France
Digital camera	Nokia X2

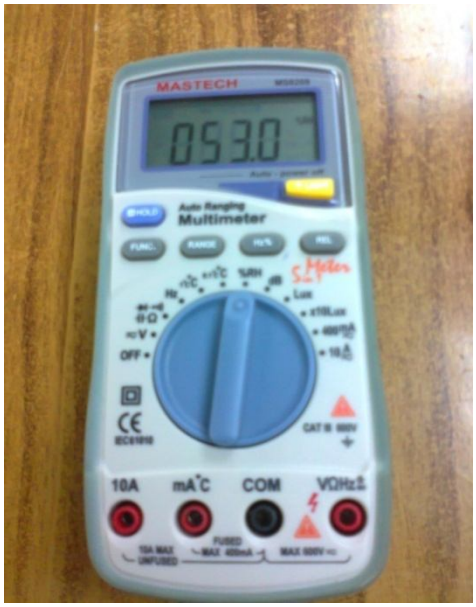


Figure 3.1 Auto ranging multimeter

Figure 3.2 Air sampler

Table 3.18: Equipment and disposables

Cotton swab culture
Wide mouth glass bottles (250 ml, sterile)
Ice box
Cotton
Alcohol

Table 3.19: Culture media

Culture media	Manufacturer
Blood agar	HiMedia- India
MacConkey agar	HiMedia- India
Dichloran Rose Bengal Chloramphenicol (DRBC) agar	Oxoide- UK
Nutrient agar	HiMedia- India
Tryptic soy broth (TSB)	HiMedia- India

3.15 Environmental Samples

3.15.1 Microbiological samples description

Different samples were collected from the ICUs; Air samples for evaluation of air quality and ventilation system, that was from both indoor air and mechanical ventilator machines in the ICUs, water samples for evaluation of water quality, swab culture to evaluate environmental surfaces cleansing and swab culture to evaluate instruments and equipments cleansing.

1. Air sampler was used to collect bacterial and fungal samples from the unit's indoor air
2. Air sampler was used to collect bacterial and fungal samples from the unit's inspired air from mechanical ventilator machines.
3. Sterile wide mouth glass bottles 250 ml to collect water sample.
4. Sterile swabs were used to collect environmental samples from all environmental surfaces as nursing counter, telephone, walls, ceiling, water tap & sinks, (water tap, shower, siphon hand) of bath room and toilet.
5. Sterile swabs were used to collect environmental samples from all kind of instruments and equipments as monitors cables, dressing sets, central line sets, resuscitation equipments (Ambu bag, Ambu mask & laryngoscope), clean linens, mattresses and pillows, patient unit (monitor, ventilator , infusion pumps, syringe pumps), bed frames, wash basin, soiled suction bottle after disinfection, mechanical ventilators, heating humidifier of the mechanical ventilator, rubber piping on a suctioning machine.

3.15.2 Sampling duration and sample size

Air samples for bacterial culture and fungal culture were collected from both indoor air and inspiratory air from mechanical ventilator over a period of two months (October and November 2012). A total of 56 air samples were obtained from the two ICUs. 32 air samples were **c**ollected from Shifa ICU, and rest 24 samples from EGH ICU. These air samples were collected into two phase, in the first phase half of the samples were collected in October 2012, the other half was collected in the second phase in November 2012.

Water samples from the wash water, drinking water and water from disinfectant basin (for instrument disinfection) were collected over one month (December 2012). A total of 20 samples were obtained from the two ICUs. 12 samples from Shifa ICU, and another 8 from EGH ICU. The samples were repeated twice during the month. Half of the samples were collected in the first week of December, the other half was collected in the third week of the same month.

Sterile swabs from environmental surfaces and all kind of instruments and equipments were collected over a period of two months (October and November 2012). A total of 120 swabs culture were obtained from the two ICUs. A total of 89 swabs culture were collected from Shifa ICU, and another 31 from EGH ICU. All of these swabs were moistened swab with a broth media as pre-enrichment media e.g. tryptic soy broth (TSB) which used in this study for 24 hours then cultured on Blood and MacConkey agars according to (CDC, 2007). In addition, these swabs collected into two point of time, half of the samples were collected in October, the other half was collected in November. Samples are summarized in table (3.19).

Table 3.20: Microbiological samples from the two ICUs

No	ICU		Shifa	EGH	Total
1	Air samples	Indoor	16	16	32
		Ventilator	16	8	24
2	Water samples		12	8	20
3	Swabs culture		89	31	120
	Total		133	63	196

3.15.3 Sampling methodology and processing

1. Air samples

An air sampler (Sampl'air- AES CHEMUNEX, France) was used to collect air samples. The apparatus is designed to pump 50 liters of air through the target media plate.

a- Indoor air

Samples collected from different sites. These sampling instruments were placed 1.2 to 1.5 m above the floor to simulate the human breathing zone from indoor air (Tang et al., 2009), as counter area, between patients units and storage room (figure 3.4).

Tested spots are detailed in annexes (5).

Figure 3.3 Indoor air sample

b- Inspiration air from mechanical ventilator machines.

Although, different mechanical ventilator machines were selected to be tested, machines connected to patients were tested as the same as not connected (standby), (figure 3.5), (figure 3.6). Sterile test lung bag was used to collect inspired air from each MV of the selected sample.

Figure 3.4 Inspiratory air from MV sample, Shifa

Selection was by testing all machines connected to patients and to select randomly one to two machines which are standby to receive new patients. Test was repeated twice without test the same machines in the two times unless it was connected to different patient.

In Shifa ICU two ventilators were connected to patients at the two time, all of them were tested, in addition to other two ventilator which were standby. However, in EGH ICU one ventilator was found to be connected to patient in the two work visits, for our good luck it wasn't the same one in each visit, other two machines were tested which were standby. Once there was homogeneous results about colony counts of bacteria and fungi in all ventilator machines in each unit and no significant

Figure 3.5 Inspiratory air from MV sample, EGH ICU

difference. So general total average were calculated for each unit for evaluation as needed by evaluation checklist (fitness checklist).

Culture media

Nutrient agar plates were used to collect samples for bacterial count, transferred to the laboratory in ice box, incubated for 48 hours at 37^{o}C then growing colony was counting. Dichloran Rose Bengal Chloramphenicol (DRBC) agar was used to collect samples for fungal count, transferred to the laboratory in ice box and incubated for 5 days at 25^{o}C before counting the grown colonies.

Bacterial and Fungal count calculation

The number of growing colony was multiplied by 20 to get results per cubic meters in order to compare with the available stander of Hong Kong.

2. Water samples

Sterile wide mouth glasses bottles (250) ml to collect water sample were used. Thiosulfate Ringer was added to the bottles as policy in Public health laboratory, this solution is used for neutralization of residual chlorine. Burning of the water tap opening was done to ensure results of pure water out of contamination. On the other hand, sterile syringe was used to fill the bottles of 250 ml of water from disinfectant basin from Shifa ICU. The last was not done in EGH ICU because of unavailability of permanent disinfectant basin.

Figure 3.6 Burning of the water tap

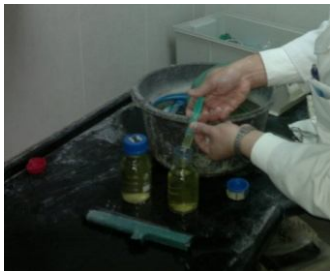


Figure 3.7 collection of water from disinfectant basin using sterile syringe

Figure 3.8 water sample collection

3. Environmental surfaces samples

Sterile swabs filled with 3 ml of Tryptic soy broth (TSB) were used to swab approximately 10 cm^2 of each environmental spot (tested spots are detailed in annex 3). Swabs were then incubated overnight at 37^oC and tested for turbidity. All samples were cultured on Blood and MacConkey agars and incubated overnight at 37^o C.

Positive cultures grown on both plates (Blood and MacConkey agars) were submitted to biochemical identification (API 20E), cultures grown only on Blood agar were gram stained. Gram positive cocci isolates were submitted to slide Catalase test (3% H2O2 solution). Catalase positive isolates were submitted to tube method Coagulase test.

Figure 3.9 Swabs culture collection

Figure 3.10 Tryptic soy broth (TSB)

On the other hand, after get the first result on October, that was significantly horrible. Coordination with infection control committee in Shifa hospital was done, because of the strange wide of difference rather than the data they have. The story was in the different technique in which swabs were taken by the researcher and the other technique that regularly have been used by infection control committee and laboratories of the MOH hospitals, and so at the second point of time in November, further samples at the same time and from the same site was swabbed side to side by the researcher and the members of infection control committee in Shifa hospital. Thus, moistened with normal saline is the way in which infection control committee of the MOH hospitals usually takes their cultures. And direct cultured is the way in which the MOH laboratories regularly culture their swabs.

3.16 Environmental Measurements

3.16.1 Measurements description

Auto ranging multimeter was used to measure atmospheric temperature and relative humidity in the two units. Readings were collected over a period of one month (October 2012). A total number of reading in the two units were 516, taken from different sites and different points of times around the day. Sites and time are detailed in annexes (5,6,7). 204 reading measures were taken from Shifa ICU, half of them to measure temperature and the other half to measure relative humidity. The rest 312 reading measures were taken from EGH ICU, 156 of them to measure temperature and the rest for relative humidity.

Samples are summarized in table (3.20)

Table 3.21: Measurements reading from the two ICUs

No	ICU	Shifa	EGH	Total
1	Temperature measurements	102	156	258
2	Relative humidity measurements	102	156	258
	Total	204	312	516

3.16.2 Measurement processing

Auto ranging multimeter was used to measure atmospheric temperature and relative humidity in the two units**.** Two to three days from each week along the month was selected to collect measurement readings. Many different point of time were selected to gathering readings as follow: 7am, 8 am, 12 MD, 2 pm, 6 pm, 8 pm, 12 MN, 6 am.

Figure 3.11 atmospheric temperature and relative humidity measurement collection

Moreover that, many different sites were considered to get measurement from the two ICUs as counter area, north, south, west and east side in both ICUs, and storage room of each one. Once there was no significant difference in readings among all sites, overall total range for each unit and storage room were calculated for evaluation as needed by evaluation checklist (fitness checklist). Example for sites selection are described in Shifa ICU map, (annex 5).

3.17 Limitation of the study

1. Limited educational resources, particularly updated books and journals.
2. Lack of financial resources.
3. Follow up of HCPs during work schedules of different shifts.
4. Electricity.

Chapter IV

Results and Discussion

4.1 Environmental Infection Control Measures

4.1.1 Walk around infection control checklist

The researcher developed a walk around checklist in order to be provided to the infection control committee in MOH hospitals as an evaluation tool to evaluate existing environmental infection control measures by routine wake around checking.

The tool is constructed to calculate the compliance percentage at the end of the evaluation, simple calculation formula was established for that aim. Complete description of the checklist in annex (11).

4.1.2 Application of checklist "Fitness checklist" on Shifa and EGH ICUs

Table 4.1: Evaluation of Environmental IC measures "Fitness checklist"

	Group	Shifa				EGH			
		fit		unfit		fit		unfit	
		f	%	F	%	f	%	f	%
1	**Air and ventilation system**								
A	Airborne Infectious Pathogens in ICUs	1	10.0	9	90.0	1	10.0	9	90.0
B	Temperature	0	0.0	2	100	0	0.0	2	100.
C	Humidity	1	50.0	1	50.0	1	50.0	1	50.0
D	Ventilation, Filtration and Pressurization	2	50.0	2	50.0	3	75.0	1	25.0
	Total	**4**	**27.5**	**14**	**72.5**	**5**	**33.75**	**13**	**66.2**
2	**Water quality and hand washing**								
A	Waterborne infectious disease in ICU	9	90.0	1	10.0	9	90.0	1	10.0
B	Hand washing facilities	2	25.0	6	75.0	4	50.0	4	50.0
	Total	**11**	**57.5**	**7**	**42.5**	**13**	**70**	**5**	**30.0**
3	**Environmental surfaces**	**4**	**33.3**	**8**	**66.4**	**5**	**41.6**	**7**	**58.4**
4	**Instruments and Equipments**	**3**	**21.4**	**11**	**87.6**	**5**	**35.7**	**9**	**64.3**
5	**Laundry**								
A	Linen	0	0.0	5	100	1	20.0	4	80.0
B	Mattresses and Pillows	1	25.0	3	75.0	1	25.0	3	75.0
	Total	**1**	**12.5**	**8**	**87.5**	**2**	**22.5**	**7**	**77.5**
6	**Health care waste management**								
A	Waste disposal	0	00.0	5	100.0	0	00.0	5	100.
B	Sharps disposal	6	75.0	2	25.0	8	100.0	0	0.0
	Total	**6**	**37.5**	**7**	**62.5**	**8**	**50**	**5**	**50**
7	**Antiseptic and disinfection**	**5**	**83.3**	**1**	**16.6**	**4**	**66.6**	**2**	**33.4**
	Total	**34**	**37.7**	**56**	**62.3**	**42**	**46.6**	**48**	**53.4**

Table 4.1: shows that in the total Evaluation of the Environmental safety measures in Shifa and EGH ICU, a percentage of 62.3% of the measures in Shifa were unfit. However, a little down percentage in EGH around 53.4%. In detailed, around 69% of

the domain of air and ventilation system fitness were unfit. Environmental surfaces cleaning (66.4, 58.4) %, Instruments and Equipments cleaning (87.6, 64.3)% and Laundry management (87.5, 77.5)% also have a high percentage of incompetent in Shifa and EGH respectively. In contrast, just (42.5, 30)% of the domain of water quality and hand washing facilities were unfit and about (16.6, 33.4)% of the domain of antiseptic and disinfection availability and using were inadequate in Shifa and EGH respectively. While Health care waste management was in around (37, 50)% of unfitness degree. On the other hand, no significant difference is observed between the two units in all domains, so total average is representative to reflect the result of evaluation fitness. More detailed are clear in the following tables about each domain.

4.1.1 Air and ventilation system

4.1.1.1 Airborne Infectious pathogens in ICUs

Table 4.2 : Bacterial and Fungal Account in ICUs

No.	Item	Finding	
		Shifa	EGH
1	Total fungi count in indoor air in ICU	60 cfu / m^3	95 cfu /m^3
2	Total bacteria count in indoor air in ICU	1170 cfu / m^3	1470 cfu / m^3
3	Total fungi count in indoor storage room air in ICU	160 cfu / m^3	320 cfu / m^3
4	Total bacteria count in indoor storage room air in ICU	820 cfu / m^3	2120 cfu / m^3
5	Total fungi count in indoor isolation room air in ICU	0 / m^3	160 cfu / m^3
6	Total bacteria count in indoor isolation room air in ICU	420 cfu / m^3	300 cfu / m^3
7	Presence of fungi in mechanical ventilator inspired air	830 cfu / m^3	0 cfu / m^3
8	Total bacteria count in indoor laundry room air in ICU	1520 cfu / m^3	1340cfu / m^3
9	Presence of fungi in mechanical ventilator inspired air	73 cfu / m^3	90cfu / m^3
10	Presence of bacteria in mechanical ventilator inspired air	370 cfu / m^3	240 cfu / m^3

Table 4.2 shows that Total bacterial count in indoor air in ICU range from (1170 cfu/m^3 to 1470) cfu/m^3 in both ICU. According to Hong Kong indoor air quality management group, the only standard found, Thus the American Federal Standard adopted particulate count for evaluation purposes and didn't mention the microbial count (Charles et al., 2005). The total bacterial count and fungal count in indoor environment of offices and public places shouldn't exceed 500 cfu/m3. In healthcare facilities, the limits should be more restricted; In well ventilated operating theaters, bacterial count shouldn't exceed 50-150 cfu/m3. In comparison with the standard the study reflect a very high counts above standard. The fungal counts are not far from the

standards (60-100 cfu/m3). Incompetent air ventilation system in both units may be the reason for high microbial numbers. This result is inconsistent with a study conducted in neonate ICU at Al Shifa and Al-Nasser's hospitals by Elbayoumi, (2011) which shown that bacterial counts range from1260 to 2160 cfu/m3 and better than the fungal counts which range from 360 to 600 cfu/m3.

Also, the study inconsistent with a study conducted in a medical ICU in northern Taiwan for 1 year by Chin-Sheng et al., (2009) , The peak concentrations of indoor bacteria and fungi were found in June (7236 cfu/m^3 for bacteria and 7807 cfu/m3 for fungi), October (3869 cfu/m3 for bacteria and 5954 cfu/m3 for fungi), and December (2964 cfu/m3 for bacteria and 11,654 cfu/m3for fungi). Approximately 27% of the bacterial samples and 17% of the fungal concentrations exceeded 1000 cfu/m^3 (Chin-Sheng et al., 2009).

Moreover, the study reflect the presence of bacterial count which ranged from 73 to 90 in the inspired air from mechanical ventilation machines, however, fungal count was 830 cfc/m^3 in Shifa ventilator. In contrast with EGH mechanical ventilation machines which was free from fungal presence. Therefore, medical gases should be free from microbial load and provided as a sterile gases. This could be explained by the poor maintenance and disinfection system between patients, particularly, if know that there is not specialized person to take care of ventilators post being used for such patient.

4.1.1.2 Heating, Ventilation, and Air Conditioning Systems in ICU

Table 4.3 : Temperature and relative humidity measures

No.	Item	Finding	
		Shifa	EGH
1	Temperature average standard (21- 24) C^o.	27.3	26.06
2	Temperature average (21- 24) in storage rooms.	27.8	26
3	**Relative Humidity** Relative Humidity average (30-60)%.	58.7	58.54
4	Relative Humidity average (30-60)% in storage rooms.	61.2	59.6

More details in annex (6,7)

Regarding climate temperature table 4.3 shows that Temperature average in Shifa ICU was more than (27^0C) in both unite and storage room, measurements was greater than it was in EGH by 1.5^0C. However, both ICUs were far than the standard in about 2-3^0C. Therefore, the temperature level average during day hours was significantly greater far than the standers in about 4^0C, thus, temperature range was 28.5^0C during day hours and around 25^0C during night hours.

On the other hand, relative Humidity level was clearly above the standard in Shifa ICU storage room, otherwise, the condition in both units were at the high limit of the standards nearly 59%.

The result of this study was better than the study conducted in a medical ICU in northern Taiwan for 1 year by Chin-Sheng et al., (2009) in term of relative humidity, but worse in term of air temperature. It was investigated the impact of patient visiting activities on the indoor climate in the medical ICU. A 4-bed room with patients in the

medical ICU was selected for long-term air monitoring of air temperature and relative humidity. The result concluded as, air temperature ranged from 21.28C to 25.88C, relative humidity ranged from 58% to 74% (Chin-Sheng et al., 2009).

Temperature should be maintained between 20°C and 24°C and humidity between 30% and 60% to inhibit bacterial multiplication (WHO, 2003) and American Institute of Architect (AIA), 2001. Heating, ventilation, and air conditioning systems in health-care facilities are designed to maintain the indoor air temperature and humidity at comfortable levels for staff, patients, and visitors; control odors; remove contaminated air; facilitate air-handling requirements to protect susceptible staff and patients from airborne health-care–associated pathogens; and minimize the risk for transmission of airborne pathogens from infected patients. Decreased performance of healthcare facility systems, filter inefficiencies, improper installation, and poor maintenance can contribute to the spread of health-care–associated airborne infections (WHO,2004).

4.1.1.3 Ventilation, Filtration and Pressurization

HEPA (High efficiency particulate air) filters are available in both ICUs. However, its high efficiency and number of air changed per hour seems to be incompetent, because of the microbial results of air sampling as shown in table 4.2; on the other hand, negative pressure is not available in Shifa ICU nor EGH ICU, moreover that there is more than one isolation room in the unit in EGH ICU in opposition with Shifa ICU which has just one isolation room.

4.1.2 Water quality and Hand washing

Count of total and fecal coliform in tap water, drinking water and water from disinfectant basin in both ICUs were negative after twice culturing from the two units. Although, water in ventilator heated humidifier was positive culture for presence of pathogenic bacteria in both ICUs. However, sterile water was used in EGH ICU in opposition with Shifa ICU which use tap water against the standers. Therefore, the water source is not the cause of infection in the ventilator heated humidifier, most likely the cause is improper disinfection for the humidifiers between patients. More detailed in annex No.8, and annex No.9.

4.1.2.1 Hand washing facilities

Elbow operated mixer tap were available in the sinks in Shifa ICU, but not in EGH ICU. However, Hand rub was not available in area wherein hand washing sink is not accessible in both ICUs according to WHO recommendation. More detailed in annex No.16.

4.1.3 Environmental surfaces

Many previous studies confirm the importance of pre-enrichment for recovery of environmental contaminants (Landers et al., 2010). Using of moistened swab with a broth media as pre-enrichment media, will find out truthfully pathogenic bacteria in environmental inanimate surfaces. Therefore, pre-enrichment of swabs in tryptic soy broth (TSB) were done by the researcher for 24 hours then cultured on Blood and MacConkey agars according to literature recommendations. Brain heart infusion broth (BHIB) was used as a pre-enrichment media of swabs, as it is another alternative of enrichment media listed by the CDC in a previous study conducted in neonate ICU in Al Shifa and Al-Nasser's hospitals by Elbayoumi, (2011).

Environmental surfaces cleaning have a high percentage of incompetent (62%), with no significant difference was observed between the two units. There is an increasing body of evidence that cleaning or disinfection of the environment can reduce transmission of healthcare-associated pathogens (Boyce, 2007). On the other hand, standard cleaning procedures have been proved to be not enough for full eradication of HAI pathogens (French et al., 2004). Improved methods of disinfecting the hospital environment are needed (Byers et al., 1998). Moreover, cleanliness is not enough to assure effective removal of pathogens and visual assessment is not a reliable indicator of surface cleanliness or of cleaning efficacy (Cooper et al., 2007)

Nursing counter, telephone, the walls, ceiling (condition vent), water tap, Sinks, toilet (water tap), siphon hand, clean linens, mattresses, pillows, bed frames and HCP uniform all of these surfaces and others are swabbed for culture (more detailed in annex No.17).

4.1.4 Instruments and Equipments cleaning

Blood gas analyzers, dressing sets, central line sets, monitors cable, resuscitation equipments (Ambu bag, Ambu mask, heated humidifier, laryngoscope, patient unit, infusion pumps, syringe pumps), oxygen humidifier, ventilator, suction irrigation bottle, wash basins and others are swabbed for culture. Swab culture results are detailed in annex 17).

Swab culture results

Table 4.4 : Bacterial finding results in ICUs by use of TSB

	Shifa hospital		**EGH**	
Bacteria	Frequency	Percentages	Frequency	Percentages
Pseudomonas	15	48.4	9	29
E-coli	11	35.4	9	29
klebsilla	4	12.9	6	19.3
Staph arues	0	0.00	5	16.1
Total of positive	**30**	**96.6**	**29**	**93.7**
Negative culture + *Staph*	3	9.7	3	9.7
Total	**33**	**106.3**	**32**	**103.4**

More detailed in annex No.17, 18

Table 4.4 shows that *Pseudomonas* nearly 48% at Shifa ICU is the highest percentage of bacterial finding in the Environmental surfaces and" Instruments and Equipments" followed by *E-coli* about 35% and then *klebsilla* around 12%. however, *Staph arues* was significantly observed in EGH ICU around 16% with complete absents in Shifa ICU during the study. On the other hand, both *Pseudomonas and E-coli* were the highest percentage of bacterial finding in the Environmental surfaces and" Instruments and Equipments" in EGH ICU in percentage of 29% of all studded cultures, followed by *klebsilla* about 19% and then *Staph arues*. Another note in the table that the total percentage is mor than 100%, mostly because some of the swabs represent more than one type of bacteria.

In summary, 96%, 93% of all the swabbed cultures in Shifa ICU and EGH ICU respectively were positive. Therefore, improved methods of disinfecting the hospital environment are needed.

Figure 4.1 : *Pseudomonas* on Blood and Makconcy agar media

Figure 4.2 : Fungus on DRBC agar from indoor air

Moreover, the same swabs were taken at the same time and from the same site by the researcher and the members of infection control committee in Shifa hospital. Thus, moistened with normal saline is the way in which infection control committee of the MOH hospitals usually takes their cultures. Then cultured directly in the MOH laboratories in which direct cultured is the way that the MOH laboratories regularly culture their swabs.

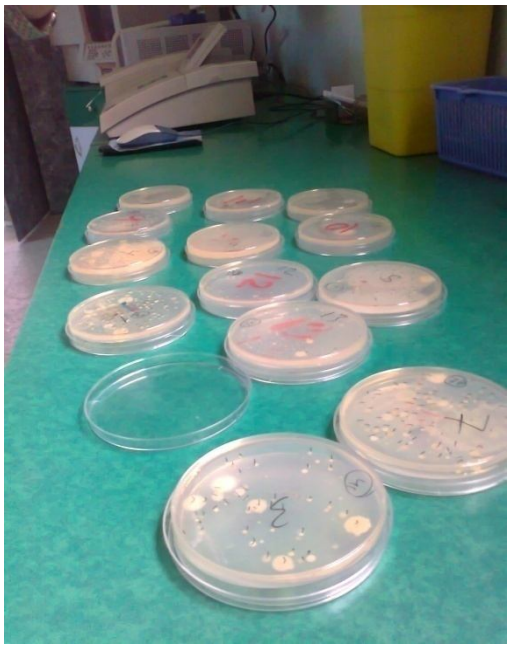
However, the results were significantly different, thus just 27% of the samples were positive as shown in table 4.5.

As a result of this experiment, using of moistened swab with a broth media as pre-enrichment media, will find out truthfully pathogenic bacteria in environmental inanimate surfaces. Therefore, when pre-enrichment of swabs in tryptic soy broth (TSB) were done by the researcher for 24 hours then cultured on Blood and MacConkey agars. mostly all of environmental inanimate surfaces swabs were positive (96%); However, just 27% of the samples were positive by the used technique in which MOH specialists habitually culture their swabs.

Which confirms the importance of pre-enrichment for recovery of environmental contaminants mentioned by other studies (Landers et al., 2010). This finding support the pre-enrichment method over the direct culture on solid agars to avoid overlooking potential pathogens which exist in low numbers but still impose risk.

This result is inconsistent with a study conducted in neonate ICU in Al Shifa and Al-Nasser's hospitals by Elbayoumi, (2011) which shown that mostly all of surface swabs were positive (95%); brain heart infusion broth (BHIB) was used as a pre-enrichment media of swabs, as it is another alternative of enrichment media listed by the CDC.

Figure 4.3 : Fungus in addition to Bacteria on Nutrient media from mechanical ventilator inspiratory air



Fungus 4.4 : Bacteria on Nutrient media from indoor air

Table 4.5 : Bacterial finding results in ICU by use of Normal Saline and direct culture

Bacteria	**Shifa hospital**	
	Frequency	Percentages
Acintobacter	2	6.1
Enterobacter	1	3.05
Bacillus	2	6.1
Dephteroids	2	6.1
Staph spp	2	6.1
Total of positive	**9**	**27.45**
Negative culture + *Staph*	25	75.75
Total	**33**	**103.2**

more detailed in annex No. 17,18

4.1.5 Laundry handling facilities

Laundry management in total have a high percentage of incompetent around 82%. Nearly 87% in Shifa ICU and 77% in EGH ICU. Special bags were available for dirty linen in EGH ICU, but not in Shifa ICU. Bed mattress and pillows were not covered with moisture-resistant cover as the first layer in both units.

Regarding HCPs uniform, Ideally clean uniforms should be worn each shift, and not worn outside the unit. ICUs need adequate supplies to ensure all staff have clean uniforms each shift. However, swab cultures results of two different nurses and doctors

in each ICUs in different point of time were contaminated with pathogenic bacteria. In addition, it is tormentor if knowing that all HCPs have to wash their own suit at their homes, because no laundry facilities available for them.

4.1.6 Healthcare waste

Health care waste management was in around 55% of unfitness degree. Nearly 60% in Shifa ICU and 50% in EGH ICU. Correct segregation of waste: domestic, infectious, and cytotoxic were not done neither in Shifa nor EGH ICU. The three colored or labeled bags for segregation of waste were not available also. Waste bag were not disposed of at 2/3 full in both units, but complete full, "against standers", that the risk of infection spreading is consider because of improper tight closing of the bags. On the other hand, persons handling wastes did not wear heavy gloves & closed shoes in both units. However, sharp containers were not properly sealed prior to disposal, and sharp boxes were not less than 3/4 full before disposing in Shifa ICU. In contrast, all items of sharp disposal in EGH ICU were positive. More detailed in annex No.16.

Figure 4.5: Persons handling wastes did not wear heavy gloves & closed shoes

Figure 4.6: Sharp boxes were not less than 3/4 full

4.1.7 Antiseptic and disinfection

However, most of the nurses instruct the cleaner to clean and disinfect soiled bottle before reuse under their supervision, all of the swabs cultures post disinfectant were positive. The proved reason was time factor, as bottles were soaked in the available chlorine disinfectant for just moments, against the CDC, 2008 recommendations for disinfectant use.

So simple experiment was done by the researcher compared by swab culture results, between the previous act and the correct soaking time in the same usually available chlorine disinfectant regardless asking for concentration. 10 minutes soaking as CDC, 2008 recommendations for disinfectant use, was enough to have negative bacterial culture results.

4.2 Healthcare Providers Knowledge and a Attitude

Results of the self administered questionnaire

The researcher distribute the questionnaire to HCPs and receive it in the same shift in the two ICUs. The action was repeated three days in different shifts each week in Shifa ICU for eight continuous weeks, and one day a week in different shifts at the same weeks period in EGH ICU.

Table 4.6: Summary of personal and professional information

		Frequency *" n"*	Percentages **%**
Gender	Male	63	86.3
	Female	10	13.7
Age	Less than 25 years	11	15.06
	25-30 Years	37	50.68
	More than 30 years	25	34.24
Marital status	Single	18	24.56
	Married	55	75.34
Profession	Specialist physician	5	6.84
	General physician	18	24.65
	RN Nurse	40	54.79
	Diploma nurse	4	5.47
	Physiotherapist	6	8.21
Last degree awarded	Diploma	5	6.84
	Bachelor	61	83.56
	Master	5	6.84
	PhD	2	2.73
Current job position	Head of department	1	1.36
	Head nurse	2	2.74
	Head of department assistant	2	2.74
	Head nurse assistant	2	2.74
	Practitioner	66	90.41
	Nurse supervisor	2	2.74
Total years of experience	Less than 5 years	37	50.7
	5-10 years	21	28.8
	More than 10 years	15	20.50

4.2.1 Personal and Professional information

1. Gender

Table 4.6 shows that 93.6% from the sample in Shifa hospital are male and 6.4 % are female , and 73.1% from the sample in EGH are male and 26.9 % are female . It is clearly observed the wide difference in participation rate between male and female, almost this is related to Gaza strip situations in general, as the female participation percentage in labor force is 13.5% in comparison with male, according to Palestinian Central Bureau of Statistics (PCBS, 2009). Thus, ICU nursing considered to be a hard

job. However, the female percentage in this study is nearly doubled the previous finding may indicate to the broad opportunity for female in medical field.

2. Age in years

Table 4.6 shows that the age group -less than 25 years- is the lowest percentage among aging groups in the study, which were (17, 11.5)% in Shifa and EGH respectively, in addition the table show that approximately 0.5% less than half (44.7%) from the sample in Shifa hospital were in the age group of 25-30 years, however, more than half (61.5%) from the sample in EGH were in the same age group. Although the aging group of more than 30 years were larger in Shifa hospital (38.3)% than its percentage in EGH (26.9)%.

3. Marital status

Regarding the marital status of the respondents the above table (4.6) shows that married respondents constituted 78.7% of the study population and the single respondents represented 21.3% of the study population in Shifa. However, no significant difference between this result and the result in EGH which were (69.2, 30.8) for married and single respectively.

4. Profession

Table 4.6 shows that the majority of the respondents were nurses who constitute around 60% in both Shifa and EGH, registered nurses had the majority 0f the percentage nearly 55% and the rest 5% were diploma nurse, in contrast the lowest percentage was among Physiotherapist who constitute around 10% , with an important not to be added that they not stay all of their time in the ICU but just they come as a visit and then leave. Although, no Specialist physician responded to the study in EGH, in contrast, all of Specialist physician in Shifa were responded 10.6%, from the other hand, the response of general physician in Shifa were most of the team with a percentage of around one quarter (25%) of the study sample in Shifa hospital, despite of the same percentage in EGH but the responders were low in number just (6), may be because of the combination between the ICU and anesthesia physician in EGH and the majority of time spending in operation room (O.R) not in ICU. Versus the condition in Shifa Hospital, that there is a complete separation between the ICU and anesthesia physician so all the time ICU physician are present.

5. Last degree awarded

Regarding Education degree table 4.6 shows that Bachelor degree is the main educational degree among HCPs with a percentage more than 80%, in contrast the PhD was the lowest percentage 4.3% particularly from Shifa hospital, the zero percentage from EGH in this degree may be because no Specialist physician responded to the study in EGH. In addition, about 8.5% from the participant were awarded master degree in Shifa, 3.8% in EGH. Although, diploma degree constitute around 7% in both Shifa and EGH, almost they were from nurses as it clear in table 4.10**.**

6. Current job position

Table 4.6 shows that Shifa Head of department participated in the study (1.37), in contrast EGH was not. However, Both Head nurse, Head of department assistant, Head nurse assistant, Nurse supervisor, participated in the study in the same percentage (1.37) in Shifa and EGH. The majority of the participants were from practitioner who have not

managerial role in a total percentage of 87% from the population sample (57.5, 30.1)% respectively in Shifa and EGH.

7. Total years of experience

Regarding the experience as showen in table 4.6 nearly 50% of the participants have less than 5 years of experience in both Shifa and EGH, that is mean the main practitioner in ICU had less than 5years experience. In a previous study conducted in Gaza about infection control in O.R in nongovernmental organization (NGO) in 2010 the result were the approximately the same. 51% of the participants have less than 10 years of experience, 34% have experience from 10-20 years and 15% have more than 20 years of experience (Elmadhoun, 2011) . On the other hand, group of 5-10 years experience were 25.5%, 34.6% in Shifa and EGH respectively. This may make equilibrium in the equation regarding the less than 5 years of experience practitioner in ICU. Moreover, around 11-15% had more than 10 years of experience in both ICU.

4.2.2 Structural and Managerial elements

Table 4.7 : Summary of structural and managerial elements

	Items	Shifa hospital ICU				EGH ICU			
		f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	**Policies**	41	16.18	197	83.8	42	32.3	88	67.68
2	**Education and training**	97	35.4	177	64.6	74	49.0	77	51.0
5	**Auditing and supervision**	94	50.0	94	50.0	60	58.8	42	41.2
	Total	232	33.15	468	66.85	176	46	207	54

Table 4.7 shows that researcher set three items to express organizational structural and managerial elements which is Policies, "Education and training" and "Auditing and supervision". In term of policies, the study results indicate that about 83.8%, 67.7% of the population sample in both Shifa and EGH respectively had no knowledge about policies regarding infection control. The difference was not significantly wide in received educational and training programs, thus 64.6% of the participant were not received any educational and training programs regarding infection control in Shifa ICU, as the same as in EGH with a percentage of 51%. On the other hand, half of the participant in Shifa ICU agree that no tangible Auditing and supervision program from managers toward infection control, the conditions were not significantly different in EGH ICU, the percentage was 41.2%. (more detailed about policies, educational and training and Auditing and supervision questions are in next tables 4.8, 4.9, 4.10.

1. Policies

Table 4.8: Knowledge about Policies

		Shifa hospital				EGH			
No.	**Items**	f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	Do you know if there is a Palestinian infection prevention and control protocol?	12	25.5	35	74.5	15	57.7	11	42.3
2	Is there a copy of the Palestinian infection prevention & control (PIPC) protocol in the department?	2	4.3	45	95.7	4	15.4	22	84.6
3	Have you seen it before (PIPC) ?	1	2.1	46	97.9	5	19.2	21	80.8
4	Have you read it before (PIPC)?	5	4.3	45	95.7	6	23.1	20	76.9
5	Does hospital management adopt policies and regulations to support the compliance to the PIPC protocols?	21	44.7	26	55.3	12	46.2	14	53.8
	Total	41	16.18	197	83.8	42	32.3	88	67.6

Table 4.8 shows that (74.5, 57.7)% of the participant in Shifa and EGH respectively did not know if there is a Palestinian infection prevention and control protocol, (95.7, 84.6)% in Shifa and EGH respectively believed that there was not a copy of the Palestinian infection prevention & control (PIPC) protocol in the department, instead of (97.9, 80.8)% of them had not seen it before, neither read it. However, nearly (55.3, 53.8)% see that hospital management did not adopt policies and regulations to support the compliance to the PIPC protocols. This result is consistent with the study of El-madhoun, (2011) showed that 63.0% of the participants did not know about the IPC protocol. As the same of El-Dalow study, (2011) which showed that 66% of the participants did not know about the IPC protocol. This result is inconsistent with a study conducted in Zambia by Katowa et al, (2007) which revealed that 86% of the respondents had heard about IP guidelines. Several other studies have indicated that the majority of HCWs in Zambia have heard about IP. Almost all participants 95% indicated that they had heard about HAI.

2. Education and training

Table 4.9: Education and training

No.	Items	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	Have you received any infection prevention & control training course ?	10	21.3	37	78.7	5	19.2	21	80.8
2	Have you received any lecture about Air & ventilation system in ICU?	4	8.5	43	91.5	4	15.4	22	84.6
3	Have you received any lecture about infection prevention & control in ICU?	29	61.7	18	38.3	20	76.9	6	23.1
4	Does your basic education curriculum incorporate training about the infection control protocols and guidelines?	22	46.8	25	53.2	16	61.5	10	38.5
5	Does your hospital provide in- service training and education about infection control protocols and guidelines?	21	44.7	26	55.3	16	61.5	10	38.5
6	If yes, does the provided training improve your performance?	11	23.4	28	59.6	13	50.0	8	30.8
	Total	97	35.4	177	64.6	74	49.0	77	51.0

Table 4.9 shows that around 78-80 % of the participant of the census study in both ICU of Shifa and EGH correspondingly, had not been received any infection prevention & control training course. Air & ventilation system in ICU is the less knowledge among team that more than (91.5, 84.6)% in Shifa and EGH respectively had not been received any lecture about air & ventilation system in ICU. However, about (46.8, 61.5)% of the participant agreed that their basic education curriculum incorporate training about the infection control protocols and guidelines and the other were not. Although, 44.7%, 61.5% in Shifa and EGH respectively, provide in- service training and education about infection control protocols and guidelines but around 59.6% in Shifa believed that provided training did not improve their performance, in contrast, just 30.8% in EGH see the opposite .

These results are consistent with that of a study conducted in Gaza at UNRWA health centers which revealed that 50% of the participants have had training about IPC, the results of this study are better than those of a study conducted in governmental pediatric hospitals by El-Dalow, (2011) which showed that 21.5% of the study population share an education or training session of IPC. Najeeb, (2007) conducted a research in Maldives found that 44.9% of doctors and nurses did not attend any form of training

program on infection control practices. Amerion et al, (2010) in his study about Knowledge of Hospital Infection Control by Supervisors in Three Selected Military Hospitals in Islamic Republic of Iran, 46.9% did not receive any specific education with regard to hospital infectious. 54.7%, however, participated in hospital infection seminars.

3. Auditing and supervision

Table 4.10: Auditing and supervision

		Shifa hospital				EGH			
No.	**Items**	f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	Is there an infection control committee in your hospital	40	85.1	7	14.9	21	80.8	5	19.2
2	Does hospital management encourage the practices of the IPC protocols?	30	63.8	17	36.2	21	80.8	4	15.4
3	Is there an auditing program to ensure that policies have been implemented?	18	38.3	29	61.7	13	50.0	12	46.2
4	Has your facility ever carried out a follow up / supervision of your practice regarding the infection prevention implementation?	6	12.8	41	87.2	5	19.2	21	80.8
	Total	94	50.0	94	50.0	60	58.8	42	41.2

Table 4.10 shows that about 80% of the participants know about the infection control committee in their hospital. However, 63.8%, 80.8% in Shifa and EGH ICU participant respectively see that their hospitals management encourage the practices of the IPC protocols. Although, 61%, 46% in Shifa and EGH ICU participant correspondingly see that there was no an auditing program to ensure that policies have been implemented.. Also, (87.2, 80.8)% of them in Shifa and EGH respectively agreed that their hospitals never carried out a follow up supervision of their practice regarding the infection prevention implementation.

4. Vaccination and Disease and injuries

Other two organizational structure and managerial elements were Vaccination and frequencies of earn disease or exposed to injuries by sharp object.

1. **Vaccination**

Table 4.11: Vaccination

		Shifa hospital				EGH			
No.	**Items**	f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	**Have you vaccinated for hepatitis B?**	36	76.6	11	23.4	21	80.8	5	19.2
2	How many doses	Non		one		two		≤ Three	
		10	21.2	7	4.30	6	8.50	50	66.0
3	**Have you ever vaccinated for influenza?**	3	6.40	44	93.6	1	3.8	25	96.2
4	How many doses	Non		one		two		≤ Three	
		69	94.5	1	1.36	1	1.36	2	2.74

Table 4.11 shows that 76.6, 80.8% of participant in Shifa and EGH correspondingly are vaccinated against hepatitis B virus. About 66% received the three doses . In contrast, just about 6.4, 3.8% in Shifa and EGH respectively were vaccinated against influenza virus. So the researcher decided not to make a total average for vaccination because of the significant difference in between the two vaccinations.

According to literatures, on the one hand of hepatitis B vaccination these results are consistent with previous studies in Gaza, the first was the study of Awad, (2009) which revealed that 85.6% of respondents have received hepatitis B vaccination and the second was the study of El-Dalow, (2011), which reported that 84.7% of the participants have received hepatitis B vaccination and 63.2% of them received three doses, the third was Elmadhoun, (2011) which revealed that 90.8% of respondents have received hepatitis B vaccination and 79.3% of them received three doses . The research results is better than the results of a research conducted in Jordan which revealed that only 36% of HCPs were vaccinated (Al-Omari, Al-Dwairi, 2005), while 11.3% of the respondents had received three doses in Egypt (Ismail et al, 2007). Another study conducted in Iran revealed that 61.5% had received complete vaccination against HBV (Askarian, 2002). Another study conducted in India revealed that 61.2 percent of the dental students had not been vaccinated with hepatitis B (Singh et al, 2011).

On the other hand, influenza vaccination is not considered at all in the system of Palestinian ministry of Health (MOH) to HCPs. However, literature approached to prove the against in the study conducted in Germany by Wicker et al., (2010) which indicate that hospitals policies now toward mandatory vaccination especially for HCWs who care for immunocompromised patients particularly as ICUs. In the study 68.4% of participants supported mandatory vaccinations for HCWs. Nurses had lower vaccination

rates, were more likely to reject mandatory vaccinations, and were less likely to be convinced that vaccinations are important for them. With the exception of HBV vaccination, this result was found for influenza vaccination. This result could reflect a higher awareness among physicians regarding the benefits of vaccinations either for patients or for themselves. However, nurses usually have both closer and longer contact with patients than any other professional group of HCWs.

Moreover , the previous results are in line with those of a recently published study of a children's hospital in Kansas City, Missouri, in which most of the HCWs (70%) thought influenza vaccination should be mandatory for HCWs (Douville et al., 2010).

2. **Disease and injuries**

Table 4.12: Disease and injuries

		Shifa hospital				EGH			
No.	**Items**	f	%	f	%	f	%	f	%
		Yes		No		Yes		No	
1	Have you get any chest infection this year ?	24	51.1	23	48.9	15	57.7	11	42.3
2	How many times	Non		one		two		≤ Three	
		34	48.9	8	10.0	18	23.5	13	17.0
3	Have you get influenza this year ?	31	66.0	16	34	21	80.8	5	19.2
4	How many times	Non		one		two		≤ Three	
		21	34.0	24	27.7	22	29.8	6	8.50
5	Have you get any urinary tract infection this year ?	8	17	39	83	5	19.2	21	80.8
6	How many times	Non		one		two		≤ Three	
		59	80.8	11	14.9	3	4.3	0	0.0
7	Have you been exposed to any injury from used needle or sharp surgical instrument ?	19	42.6	27	57.4	12	46.2	14	53.8
	Total	77	41.4	109	58.6	53	51.0	51	49.0

Table 4.12 shows that frequencies of exposing to earn disease or to get injury during working, as it is clearly shown a total of approximately 41% in Shifa and 51% in EGH of the study population exposed to disease and injuries. In more detailed, more than half of the population (50%) in the two ICUs had earn chest infection that year, particularly 23.5% of them infected twice and 17% more than three times in the same year. On the other hand 66%, 80.8% of the HCPs in Shifa and EGH respectively acquire influenza that year, nearly 29.8% of them infected twice and 8.5% more than three times in the

same year, approximately the same as the previous item of chest infection. However, around 42.4% in Shifa and 46.2% in EGH of the study population exposed to injury from used needle or sharp surgical instrument during working . Literature reported in 2012 that 10 ICU nurse earn sever chest infection in Jordan hospital, one of them had died and the other hospitalized for several days tell complete cure.

In term of needle stick this result is significantly better than the two previous studded in Gaza, that both El-Dalow and Elmadhoun, (2011) reported 66.1%, 81.6% needle stick respectively in their studded. This result is the better than that of a study which was conducted by Hassan et al., (2004) at Assiut University and recorded that 97.2% of participants were exposed to needle sticks. While the result of another study conducted at a German university hospital by Wicker et al., (2007) which reported better results as 31.4% of the participants were injured by needle stick. Another study conducted at Gharbiya Governorate, Egypt by Ismail et al., (2007) and showed that females HCPs were more likely to experience needle-stick injuries than males. HCPs who graduated from nursing school or who had lower levels of education were more likely to experience needle-stick injuries than those who had graduated from medical or nursing institutes or higher levels of education. HCPs who give injections were more likely to experience needle-stick injuries than those who do not give injections. These differences were statistically significant. However, HCPs who had received training are less likely to have a needle stick injury than those who had not ($P < 0.05$). Two-hand recapping of needles was the commonest cause of such injuries.

4.2.3 Individual factors (Knowledge and Attitude)

One Sample K-S Test

One Sample K-S test will be used to identify if the data follow normal distribution or not, this test is considered necessary in case testing hypotheses as most parametric Test stipulate data to be normality distributed and this test used when the size of the sample are greater than 50.

Results test as shown in table (4.13) , clarifies that the calculated p-value is greater than the significant level which is equal 0.05 (p-value. > 0.05), this in turn denotes that data follows normal distribution, and so parametric Tests must be used.

Table 4.13: One Sample K-S

Number	section	Statistic	P-value
1	Air & ventilation system	1.060	0.211
2	Water quality and hand washing	1.059	0.212
3	Environmental surfaces	0.634	0.816
4	Instruments and Equipments	0.714	0.688
5	Suctioning of sputum secretion	1.254	0.086
6	Laundry	0.630	0.822
7	Mattresses and Pillows	1.065	0.207
8	Sharp disposal	0.998	0.272
9	Cleaning aids "disinfection and sterilization	0.803	0.539
10	Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines	1.122	0.161
	All	**0.935**	**0.346**

4.2.3 Healthcare Providers Knowledge

Table 4.14: Summary of HCPs knowledge

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	**Air & ventilation system**	293	77.9	83	22.1	170	81.7	38	18.3
2	**Water quality and hand washing**	75	53.2	66	46.8	43	55.1	35	44.9
3	**Environmental surfaces**	102	54.3	86	45.7	52	50.0	52	50.0
4.1	**Instruments and Equipments**	72	51.1	69	48.9	49	62.8	29	37.2
4.2	**Suctioning of sputum secretion**	74	52.5	67	47.5	48	61.5	30	38.5
5	**Laundry** " Linen and pillows".	55	26.1	57	73.9	37	31.7	93	68.2
6.1	**Healthcare waste disposal**	63	67.0	31	33.0	37	71.2	15	28.8
6.2	**Sharp disposal**	83	58.9	58	41.1	40	51.3	38	48.7
7	**Disinfection and Antiseptic**	176	62.4	106	37.6	98	62.8	58	37.2
	Total	**993**	**57.1**	**746**	**42.89**	**574**	**59.66**	**388**	**40.3**

The researcher evaluate HCPs knowledge about Environmental infection control EIC concepts and the proper standard precautions SP needed**,** table 4.14 shows that the items of evaluation were seven items nominated as Air & ventilation system, Water quality and hand washing, Instruments and Equipments, Environmental surfaces, Laundry handling, Healthcare waste disposal including sharp objects and Disinfection and Sterilization measures. A total percentage of 66.2% of the participant answered non correct answers in Shifa ICU, similar to the percentage of EGH ICU of 70%.

This result is opposition with three studies conducted in Gaza; Abuzaid study showed that 56% of the respondents were familiar with the knowledge about standard precautions SP as an important aspect of infection control (Abuzaid, 2010), Awad, (2009) revealed that 73% of HCPs have knowledge about SP and the study of El-Dalow, (2011) showed that 59.3% know about SP. Also it is opposition with a study conducted in Iran by Motamed, (2002) which showed that 65.8% of the total population was familiar with SP. Another study reported a high knowledge of SP where 92% of the respondents claimed knowledge about universal precautions (Hesse et al, 2006). A recent study conducted in Tehran showed that the percentages of participants with good and acceptable knowledge regarding infections control in hospitals 1, 2 and 3 were 64.91, 60 and 66.7 respectively. Distribution of respondents with good knowledge by gender shows 54.5% in men and 25.8% in women. By marital status, 62.5% in singles and 64.2% in married (Amerion et al, 2010).

However, the results in the table 4.14 reflect the low knowledge of HCPs about EIC, which require more education and in-service training to improve and update the HCPs knowledge.

4.2.4 Health care Providers Attitude

This part of the questionnaire was directed to ask the respondents about their attitude and the scale was

1.**Strongly disagree**	**2. Disagree**	**3. Undecided**	**4. Agree**	**5. Strongly agree**

In the following tables We use a one sample t test to test if the opinion of the respondent in the content of the sentences are positive (weight mean greater than "60%" and the p-value less than 0.05) or the opinion of the respondent in the content of the sentences are neutral (p- value is greater than 0.05) or the opinion of the respondent in the content of the sentences are negative (weight mean less than "60%" and the p-value less than 0.05)

Table 4.15: Summary of HCPs Attitude

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
1	**Air & ventilation system**	3.6	0.568	71.8	8.8	0.000
2	**Water quality and hand washing**	3.99	0.861	78.1	7.3	0.001
3	**Environmental surfaces cleaning**	3.91	0.784	68	6.6	0.000
4	**Instruments and Equipments disinfection**	3.41	0.981	68.2	3.6	0.001
5	**Equipments of suctioning of sputum secretion**	3.45	0.669	68.9	5.7	0.000
6	**Laundry**. Linen	3.90	0.725	78.0	10.6	0.000
7	**Laundry :** Pillows and mattress	4.11	0.708	82.1	13.3	0.000
8	**Healthcare waste management**	4.19	0.828	83.8	12.3	0.000
9	**Sharp disposal**	3.01	1.135	60.1	0.05	0.959
10	**Disinfection and Sterilization**	3.25	0.645	65.0	3.3	0.001

In the above table 4.15 we use a one sample t test to illustrate the opinion of the respondent about environmental infection control EIC concepts. The results in table 4.22 indicate that all ICU HCPs in this census study had positive attitude toward EIC (weight mean greater than "60%" and the p-value less than 0.05) except in sharp disposal. The sign of the test is positive, so the mean of these statements is significantly greater than the hypothesized value 3. We conclude that the respondents agreed to these statements and their answers located between agree and strongly agree.

Therefore, this result are consistent with two previous studies in Gaza, (Elmadhoun, 2011) and (El–Dalow, 2011), both of the studies demonstrate positive attitude of the responders towards IPC. However, In a study conducted in the Department of Surgery, College of Health Sciences, and University of Ghana on Knowledge, Attitude and

Practice Universal Basic Precautions by Medical Personnel in a Teaching Hospital, results showed that all respondents except one person said that SPs reduce the risk of HIV transmission. About 96% of the respondents agreed that SPs should be practiced for all patients (Hesse et al, 2006).

1. **Air & ventilation system**

Table 4.16: HCPs Attitude about Air & ventilation system

No.	Items	Mean	Stand-ard deviat-ion	Weight mean	t-value	P-value
71	Windows and doors should kept closed as much as possible.	3.90	1.082	78.1	7.14	0.00
72	The standards of air ventilation system for infection control in your unit is met (minimum total air change is at least six air exchanges per hour ACH).	3.21	0.957	64.1	1.8	0.07
73	Temperature level average in your unit is satisfactory	3.25	1.211	64.9	1.74	0.08
74	Your provided care is affected negatively by unsatisfactory temperature level average in your unit	3.99	0.874	79.7	9.64	0.00
	Total	3.59	0.568	71.8	8.82	0.00

The above table 4.16 shows that the total mean for this item is equal 3.59 and the weight mean equal 71.8% which is greater than " 60%" and the value of t test equal 8.817 which is greater than the critical value which is equal 2.0 and the p- value equal 0.000 which is less than 0.05, that is mean that all HCPs in this census study had positive attitude towards Air & ventilation system. Therefore, 78% of the HCPs agreed that windows and doors should kept closed as much as possible (**t-value** 7.138 more than 2.0, **P-value** 0.000 less than 0.05), and 71% decided that their provided care was affected negatively by unsatisfactory temperature level average. However, 64.11% of the HCPs in doubt if standards of air ventilation system for infection control in their unit had been met **(t-value** 1.835 less than 2.0, **P-value** 0.071 more than 0.05). On the other side 64.93% of them disbelieved that temperature level average in their units was satisfactory **(t-value** 1.740 less than 2.0, **P-value** 0.086 more than 0.05).

2. Water quality and hand washing

Table 4.17: HCPs Attitude about Water quality and hand washing

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
71	Hand washing is the most proper way for infection control in.	4.49	1.271	89.86	9.408	0.00
72	Available water is high quality (no visible pollution indicator as verdigris or deposited materials)	2.95	1.322	58.90	-0.354	0.72
73	Hand rub need to be alternative of hand washing	4.53	1.237	80.68	8.217	0.00
74	**Total**	3.99	0.861	75.66	5.73	0.00

Table 4.17 shows that the total mean for this item is equal 3.99 and the weight mean equal 75.66% which is greater than " 60%" and the value of t test equal 5.73 which is greater than the critical value which is equal 2.0 and the p- value equal 0.001 which is less than 0.05, that is mean that all HCPs in this census study had positive attitude towards water quality and hand washing. Therefore, 89.86% of the HCPs agreed that hand washing was the most proper way for infection control (**t-value** 9.408 more than 2.0, **P-value** 0.001 less than 0.05), and 80.68% agreed that hand rub need to be alternative of hand washing (**t-value** 8.217 more than 2.0, **P-value** 0.001 less than 0.05). However, 58.90% of the HCPs disagreed that available water is high quality (no visible pollution indicator as verdigris or deposited materials) **(t-value** -0.354 less than 2.0, **P-value** 0.724 more than 0.05).

3. Environmental surfaces

Table 4.18: HCPs Attitude about Environmental surfaces

No.	**Items**	**Mean**	**standard deviation**	**Weight mean**	**t-value**	**P-value**
71	The floor should not be covered with ceramic.	4.11	1.173	62.19	7.98	0.000
72	Gloves use between all patients is a useful strategy for reducing risk of infection.	3.58	1.374	71.51	3.579	0.001
73	Sterile items will be affected from dust, moisture, insects and extremes of temperature and humidity in storage rooms.	4.05	0.970	71.10	8.323	0.000
		3.9	1.17	68.26	6.62	0.000

Table 4.18 shows that the total mean for this point is equal 3.9 and the weight mean equal 68.26% which is greater than " 60%" and the value of t test equal 6.62 which is greater than the critical value which is equal 2.0 and the p- value equal 0.000 which is

less than 0.05, that is mean that all HCPs in the study had positive perception towards environmental surfaces. Therefore, 62.19% of the HCPs agreed that The floor should not be covered with ceramic (**t-value** 7.98 more than 2.0, **P-value** 0.000 less than 0.05), and 71.51% agreed that gloves use between all patients is a useful strategy for reducing risk of infection (**t-value** 3.579 more than 2.0, **P-value** 0.001 less than 0.05). Also, 71.10% of the HCPs decided that sterile items will be affected from dust, moisture, insects and extremes of temperature and humidity in storage rooms **(t-value** 8.323 more than 2.0, **P-value** 0.000 less than 0.05).

4. Instruments and Equipments

Table 4.19: HCPs Attitude about Instruments and Equipments

No.	**Items**	**Mean**	**standard deviation**	**Weight mean**	**t-value**	**P-value**
71	Monitors, ventilator, infusion pumps, syringe pumps and prepared suction bottles should be clean, free from dust & disinfected daily & between patients by nurse.	3.53	1.226	70.7	3.724	0.000
72	Monitors cables should be clean, free from dust & disinfected daily & between patients by nurse.	3.47	1.203	69.3	3.308	0.001
73	Bed frames should be clean, free from dust and disinfected daily & between patients by nurse .	3.21	1.321	64.2	1.338	0.185
74	**Total**	3.41	0.981	68.2	3.583	0.001

Table 4.19 shows that the total mean for this section is equal 3.41 and the weight mean equal 68.22% which is greater than " 60%" and the value of t test equal 3.4 which is more than the critical value which is equal 2.0 and the p- value equal 0.000 which is less than 0.05, that is mean that all HCPs in the study had positive opinion towards instruments and equipments disinfection. Therefore, (70.7%) of them see that monitors, ventilator, infusion pumps, syringe pumps and prepared suction bottles should be clean, free from dust & disinfected daily & between patients by nurse. (**t-value** 3.724 more than 2.0, **P-value** 0.000 less than 0.05). However, 64.17% of the HCPs differed that bed frames should be clean, free from dust and disinfected daily & between patients by nurse **(t-value** 1.338 less than 2.0, **P-value** 0.185 more than 0.05).

5. Suctioning of sputum secretion

Table 4.20: HCPs Attitude about Equipments of suctioning secretion

No.	Items	Mean	standard deviation	Weigh t mean	t-value	P-value
1	Suction catheter should be attached after doing suction to be ready for second suction .	3.08	1.392	61.64	0.504	0.615
2	Suction bottle are disinfected in satisfactory manner for reuse	3.27	1.134	65.48	2.065	0.043
3	Sterile water should be use for suction tubes irrigation post each suctioning procedure	3.49	1.069	69.86	3.942	0.000
4	Irrigation container should be disposable	3.95	0.941	78.90	8.580	0.000
5	**Total**	3.45	0.669	68.97	5.728	0.000

Table 4.20 shows that the total mean for this division is equal 3.45 and the weight mean equal 68.97% which is greater than " 60%" and the value of t test equal 5.7 which is more than the critical value which is equal 2.0 and the p- value equal 0.000 which is less than 0.05, that is mean that all HCPs in the study had positive estimation towards infection control strategy for suctioning of sputum. Therefore, (78.9%) of them granted that irrigation container should be disposable (**t-value** 8.580 more than 2.0, **P-value** 0.000 less than 0.05). Also, 69.86% strong-willed use of sterile water for suction tubes irrigation post each suctioning procedure (**t-value** 3.942 more than 2.0, **P-value** 0.000 less than 0.05). However, 65.48% of the HCPs disagreed that suction bottle are disinfected in satisfactory manner for reuse **(t-value** 2.065 nearly equal 2.0, **P-value** 0.043 more than 0.05). On the other hand, 61.64% of them refuse that suction catheter should be attached after doing suction to be ready for second suction **(t-value** 0.504 less than 2.0, **P-value** 0.615 more than 0.05) which is already a negative performance within infection control measures.

6. Laundry

Table 4.21: HCPs Attitude about Linen collection

No.	Items	Mean	standard deviation	Weigh t mean	t-value	P-value
1	Soiled linen should be disposed in a water-soluble bag then plastic bagged.	3.99	0.842	79.73	10.014	0.000
2	Soiled linens should be labeled	3.82	1.032	76.44	6.805	0.000
3	**Total**	3.90	0.725	78.08	10.657	0.000

Table 4.21: HCPs Attitude about Mattresses and Pillows

No.	Items	Mean	standard deviation	Weigh t mean	t-value	P-value
1	Mattress and pillow covers should not be replace if they become torn or otherwise in need of repair.	4.11	0.936	82.19	10.125	0.000
2	Mattresses should kept dry & should be discard if they become and remain wet or stained.	4.11	0.809	82.19	11.719	0.000
3	**Total**	4.11	0.708	82.19	13.384	0.000

In this section, around 80% of HCPs in the study had positive opinion towards infection control strategies in term of laundry management (**t-value** 10.657 more than 2.0, **P-value** 0.000 less than 0.05) for linen and (**t-value** 13.384 more than 2.0, **P-value** 0.000 less than 0.05) for mattresses and pillows.

7. Healthcare waste management

Table 4.22: HCPs Attitude about Domestic and Infectious waste collection

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
1	**Medical waste** Correct segregation of waste: domestic, infectious, and cytotoxic should done	4.19	0.828	83.8	12.304	0.00
2	**Total**	4.19	0.828	83.8	12.304	0.00

In the sector of healthcare waste management, table 4.22 shows that the 83.8% of HCPs in the study had positive opinion towards infection control strategies in term of domestic and infectious waste (**t-value** 12.304 more than 2.0, **P-value** 0.000 less than 0.05).

Table 4.23: HCPs Attitude about Sharp disposal

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
1	Used needles should not be removed from syringes before disposal.	3.23	1.541	64.66	1.291	0.20
2	Used needles should not be recapping prior disposal.	2.78	1.627	55.62	-1.151	0.25
3	**Total**	3.01	1.135	60.14	0.052	0.95

However, table 4.23 shows that 64.66% of the participant doubted about removed of syringes from used needles before disposal **(t-value** 1.291 less than 2.0, **P-value** 0.201

more than 0.05). Also, 55.62% of them had negative attitude toward recapping of used needles prior disposal **(t-value** -1.151 less than 2.0, **P-value** 0.253 more than 0.05). Therefore, it is recommended in the WHO, CDC and PICP protocol for sharp disposal.

8. Disinfection and Sterilization

Table 4.24: HCPs Attitude about Disinfection and Sterilization

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
1	Instruments need to brushed well before soaked in disinfectant.	4.23	0.717	84.66	14.686	0.00
2	Instruments are not need to allowed to dry before sterilization.	2.64	1.085	52.88	-2.805	0.00
3	The laryngoscope and anesthesia instrument should be cleaned with disinfectant solution after each use	2.88	1.280	57.53	-0.823	0.41
4	**Total**	3.25	0.645	65.03	3.331	0.00

Finally the section of disinfection and sterilization aids use, table 4.24 shows that 65.03% of HCPs in the study had positive opinion towards infection control strategies in term of use of disinfectants (**t-value** 3.331 more than 2.0, **P-value** 0.001 less than 0.05). it is clearly shown that 84.66% of them granted the instruments need to brushed well before soaked in disinfectant **(t-value** 14.686 greater than 2.0, **P-value** 0.000 more than 0.05). However, 52.88% of them had significantly negative attitude in the direction of allowing the instruments to dry before sterilization **(t-value** -2.805 less than 2.0, **P-value** 0.006 less than 0.05). and the same negative perception headed for cleaning of laryngoscope and anesthesia instrument with disinfectant solution after each use **(t-value** -0.823 less than 2.0, **P-value** 0.413 more than 0.05).

4.2.5 Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines

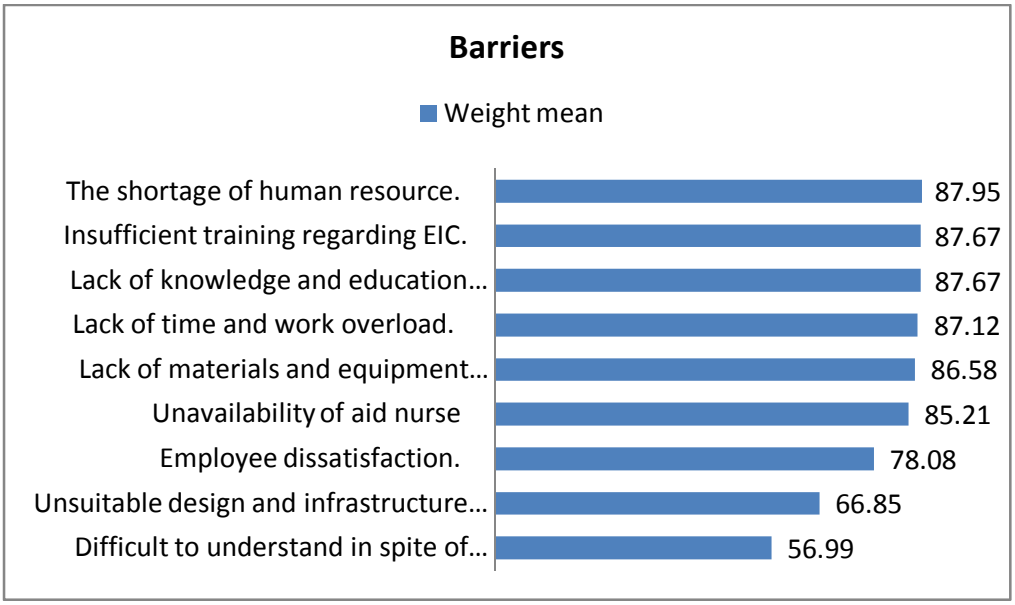


Figure 4.7 Barriers that decrease HCPs commitment to EIC

Table 4.25: Barriers that decrease HCPs commitment to EIC guidelines

No.	Items	Mean	standard deviation	Weight mean	t-value	P-value
1	Unsuitable design and infrastructure of the ICU to environmental infection control (EIC) .	3.34	1.121	66.85	2.611	0.011
2	Lack of materials and equipment regarding EIC.	4.33	0.708	86.58	16.031	0.000
3	Lack of knowledge and education regarding EIC.	4.38	0.637	87.67	18.543	0.000
4	Insufficient training regarding EIC.	4.38	0.680	87.67	17.393	0.000
5	Difficult to understand in spite of lectures and training.	2.85	1.210	56.99	-1.064	0.291
6	Employee dissatisfaction.	3.90	1.043	78.08	7.406	0.000
7	Lack of time and work overload.	4.36	0.839	87.12	13.803	0.000
8	The shortage of human resource.	4.40	0.759	87.95	15.729	0.000
9	Unavailability of aid nurse	4.26	0.913	85.21	11.790	0.000
10	Lack of supportive policy & auditing programs .	4.36	0.734	87.12	15.797	0.000
11	No accountability and feedback from administration.	4.05	0.926	81.10	9.729	0.000
12	Lack of guidelines from colleague and superior.	4.01	0.890	80.27	9.735	0.000
	Total	4.05	0.508	81.06	17.710	0.000

There are many barriers that prevent or reduce the adherence of HCPs to EIC guidelines and IPC protocols. Many obstacle have been mentioned in the literature and the researcher chooses most common of them and examined which of the items are considered barriers to implementing the protocols. Figure (4.7) illustrate these obstacles. Three studies conducted in Gaza regarding the compliance of IPC protocols, agreed with this study with different ranking of the barriers, El- madhouen, 2011 ranked the barriers as Lack of knowledge and education regarding IPC, Insufficient training, Lack of supportive policy, Lack of materials and equipment, Lack of time and work, Unsuitable design and infrastructure of the OT, Employee satisfaction, Difficult to understand. However, El-Dalow, (2011) ranked the causes as the absence of education, lack of knowledge, lack of required supplies and workload and insufficient time followed by no feedback of performance were the main barriers, and Awad, (2009) reported that the main cause was absence of training programs, followed by the lack of knowledge and education, lack of time and work overload , insufficient supplies and finally no accountability and feedback of performance. However, outside Gaza, (Pittet 2001) conducted a study in the University of Geneva Hospitals in Switzerland, addressed many barriers such as the lack of adherence with recommendations inaccessible supplies, interference with worker-patient relation, forgetfulness, ignorance of guidelines, insufficient time, high workload and understaffing, and lack of scientific information.

4.3 Evaluation of healthcare providers practices toward EIC

Result of Observation checklist

The second observational checklist for HCPs practices, the checklist were filled three times to reflect the actual practices of HCPs. And so, 68 HCPs 38 nurses and 30 physicians were observed to obtain 204 filled checklist, in a total of 16524 observations for different practices. The researcher compare between adherence of all nurses and all physician to EIC practices. However, another comparison between HCPs in general at Shifa and EGH ICUs regarding compliance to EIC.

4.3.1 Comparison between nurses and doctors performance

Table 4.26: Summary comparison between nurses and doctors performance

No.	Item	Nurses				Doctors			
		f	%	f	%	f	%	f	%
		Not applied		Applied		Not applied		Applied	
1	**Keeping air quality at unit environment**	27	35.5	49	64.5	32	53.3	28	46.7
2	**Hand washing**	142	62.3	86	37.7	113	62.8	67	37.2
3	**Personal protective equipment**	100	43.9	128	56.1	83	46.1	97	53.9
4	**Uniform**	0	0.0	38	100.0	17	56.7	13	43.3
5	**Handle laundry linens**	100	43.9	128	56.1	0	0.0	0	00.0
6	**Instruments and Equipments** General Instruments and Equipments	153	57.7	112	42.3	m	m	m	m
7	Equipments of patient airway management	83	34.0	161	66.0	m	m	m	m
8	**Instruments and Equipments of invasive procedures.** Central Venous Catheter(CVC)	102	67.1	50	32.9	57	63.3	33	36.7
9	Peripheral Venous Catheter(PVC)	145	63.6	83	36.4	101	78.9	27	21.1
10	IV Fluids and Medication	190	83.3	38	16.7	00	00.0	0	0.0
11	Folly's catheter	90	49.5	92	50.5	93	62.0	57	38.0
12	**Use of antiseptics and disinfectant solutions**	142	53.4	124	46.6	56	46.5	64	30.5
13	**Healthcare waste disposal**	67	88.2	9	11.8	28	93.3	2	6.7
14	Sharp disposal	47	30.9	105	69.1	53	44.2	67	55.8
	Total	**1388**	**53.6**	**1203**	**46.4**	**388**	**60.9**	**250**	**39.1**

For more details see annex No. 20

In total, both nurses and physicians practices commitment to infection control protocols were poor in about 46.4% adherent to infection control measures and 39.1% for doctors.

It is clearly revealed that there was relatively more commitment of applied implementations among nurses than physicians in a percentage around 7.5% .The magnitude difference observed in altering air quality at unit environment by physician in about 25% difference of malpractices. However, about 50% of the nurses applied implementations were out of conditions. Particularly, IV fluids and medication administration and healthcare waste disposal were the highest poor implementations among nurses nearly 80%. However, physicians unhealthy performances in terms of central and peripheral venous catheter (PVC) ranged above 60%, and healthcare waste disposal still the highest malpractices reported among physicians also slightly more the above mentioned percentage (93.3%).

4.3.1.1 Keeping air quality at unit environment

The first part was about the provider's behavior regarding keeping air quality at unit environment (table 4.26), 64.5% of the respondents nurses adhered to keep air quality at unit environment, but just 46.7% of the physician did so. For example, in term of keeping windows and doors closed as much as possible nurses adhered in percentage of 78.9%. In contrast, 76.7% of the physician did not.

4.3.1.2 Hand washing

Regarding the hand washing as shown in table 4.26 just around 37.5% of both nurses and physicians adhered to hand washing protocols and guidelines. However, 62.5% did not. The highest percentage of adherence was in the item of hand washing after touching blood or body fluids in the both groups (88%). In contrast, the lowest percentage of adherence were in the items of turn of water after hand washing using paper towel if elbow mixer not available (100%), followed by washing hands for 15-30 seconds with soap and running water (93%), before touching the patients (98%), after removing gloves (100%) and use hand rub in area wherein hand washing sink is not accessible in percentage of (100%) but the last was because of unavailability of the hand rub material. These results are consistent with two previous studies in Gaza, both El-Dalow and Elmadhoun, 2011, reported similar results in hand washing compliance. Out of Gaza, in the study conducted in Universities Wijaya Kusuma Surabaya, in Indonesia, hand hygiene compliance was poor (20%; 57/281; 95% CI: 16-25%). However, in this study the significant difference between nurses and physician was in the item of hand washing before performing a septic invasive procedures 84.2% for nurses and 30% for physicians.

4.3.1.3 Personal protective equipment

As shown in table 4.26 half of the HCPs (54%) adhered to wear PPE which is considered an essential part to negate the risk of cross infection and to maintain the safety for both providers and patients, with no significant difference between nurses and physicians practices. Moreover, the correct worn and maintained of personal protective equipment as face mask and sterile gowns neither the commitment to wear or use PPE when caring patients were the highest percentage nearly (62%) demonstrate the low commitment of HCPs to wear PPE.

4.3.1.4 Uniform

Regarding wearing uniform (table 4.26), significant difference between commitment of nurses and physicians in the two units was observed 100% for nurse and less than half (43.3%) for physicians.

4.3.1.5 Handle laundry linens

This item is away from comparison because it is out of physicians responsibility, except the item of stick needles into the mattress through the cover. However, neither nurses or physician did that, in a percentage of 100% commitment of not applying this bad behavior (table 4.26). And so, slight above half (56%) of nurses just applied proper handling of laundry linens and other soft goods.

4.3.1.6 Instruments and Equipments

1. **General Instruments and Equipments**

   This item is out of comparison because it is away from physicians responsibility**.** And so, slight below half (42.3%) of nurses just implemented appropriate dealing with Instruments and Equipments in terms of cleaning and disinfecting.

2. **Equipments of patient airway management**

Also this item is out of comparison because physicians in ICU are not accountable to care for inpatients airway, in which most of them are intubated and attached to mechanical ventilators. And so, nurses are accountable for that, however, 66% of them implemented appropriate dealing with equipments in terms of cleaning and disinfecting**.**

3. **Invasive procedures practices .**
   1. **Central Venous Catheter (CVC)**

      Regarding practices related to CVC, no significant difference between commitment of nurses and physicians. Unfortunately, 65% of them implemented improper practices toward CVC infection control. However, sterile towels were not available to maintain sterile field during the procedure in both units.

   2. **Peripheral Venous Catheter(PVC)**

      On the subject of practices related to PVC, considerable difference between commitment of nurses and physicians in the two units. Nurses adhered to PVC infection control practices in proportion of 36.4%, in contrast with physicians that observation result reported just 21% during the study period. Unfortunately, nor of them implemented proper practices toward PVC infection control. However, removal of PVC after 24 hr post admission from emergency room in emergency situations is not considered at all.

   3. **Intravenous (IV) Fluids and Medication**

      Respecting practices related to IV fluids and medication administration, this item is out of comparison because physicians in ICU are not accountable to administer fluids and medication as one of their routine daily work, adjacent to the accountability of nurses. However, sometimes they " physicians" do, but not in all items of the judgment, so the researcher decided not to compare between

the two practices. And so, most of nurses (83.3%) applied incorrect infection control practices toward IV fluids and medication administration.

4. Folly's catheter

Concerning infection control practices related to Folly's catheter indwelling and care. No major difference between commitment of nurses and physicians in maintaining sterility and pervert cross infection. Approximately 49.5%, 62% of nurses and physicians practices respectively were against infection control guidelines. Therefore, sterile towels were not available to maintain sterile field during insertion in both units.

4.3.1.7 Use of antiseptics and disinfectant solutions

Regarding the proper use of antiseptic and disinfectant solutions, inconsiderable difference between performance of nurses and physicians in the two units. Nurses adhered to proper use of antiseptic and disinfectant solutions in percentage of 53.4%, since physicians performance reported 46.5% during the study observation period. However, allowing skin to dry or dried by sterile gauze before beginning the invasive procedure when alcohol is used was the highest unimplemented performance (96%) among HCPs of the two groups. The same as allowing Betadine to remain over skin 1-2 minutes before proceeding was nearly 72% among HCPs of the two groups.

4.3.1.8 Healthcare waste disposal

On the subject of practices related to healthcare waste disposal including sharp objects, negligible difference between performance of nurses and physicians was observed in term of discarding waste properly nearly 90% applied inappropriate performance, while three was a better commitment toward sharp disposal either the two groups, with a minor difference between performance of nurses and physicians that nurses observations reported 69.1% of accurate implementation, while physicians observations reported 55.3% of accurate implementation. However, recapping used needles reported the highest percentage (65.8 %) for nurses and (80%) for physicians of this inaccurate implementation. While, a significant difference in disposing all sharps in puncture resistance containers was observed between nurses and physicians, that nurses observations reported 84.2% of accurate implementation, in contrast with physicians observations which gave a proportion of just 40% of perfect achievement.

4.3.2 Comparison between HCPs performance in Shifa Hospital and EGH

Table 4.27 : Summary comparison between HCPs performance in Shifa Hospital and EGH

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	**Keeping air quality at unit environment**	29	33.7	57	66.3	30	60.0	20	40.0
2	**Hand washing**	358	64.0	201	36.0	192	59.0	133	41
3	**Personal protective equipment**	134	56.8	102	43.2	39	26.0	111	74.0
4	**Uniform**	60	69.8	26	30.2	25	50.0	25	50.0
5	**Handle laundry linens**	124	73.8	44	26.2	77	65.8	40	34.2
6	**Instruments and Equipments** General Instruments and Equipments	98	56.3	76	43.7	71	58.7	50	41.3
7	Equipments of patient airway management	47	35.9	84	64.1	52	43.0	69	57.0
8	**Instruments and Equipments of invasive procedures.** Central Venous Catheter(CVC)	101	58.7	71	41.3	58	58.0	42	42.0
9	Peripheral Venous Catheter(PVC)	154	65.0	83	35.0	89	47.8	97	52.2
10	IV Fuids and Medication	140	64.8	76	35.2	80	65.0	43	35.0
11	Folly's catheter	37	27.8	96	72.2	37	40.7	54	59.3
12	**Use of antiseptics and disinfectant solutions**	148	52.9	132	47.1	47	32.4	98	67.6
13	**Healthcare waste disposal**	64	98.5	1	1.5	33	80.5	8	19.5
14	Sharp disposal	72	41.9	100	58.1	28	28.0	72	72.0
	Total	**1566**	**57.6**	**1149**	**42.3**	**858**	**49.9**	**862**	**50.1**

For more details see annex No. 21

In total, All HCPs commitment to infection control protocols were poor in about 57% in Shifa ICU and approximately 50% in EGH ICU. The only significant difference was observed in HCPs adherent to wear personal protective equipment, that reported 43.2% in Shifa ICU and 74% in EGH ICU and healthcare waste disposal remain the highest malpractices above 85% were reported in the two site of the study.

4.3.2.1 Keeping air quality at unit environment

The first part was about the provider's behavior regarding keeping air quality at unit environment, 66.3% of the respondents from Shifa ICU adhered to keep air quality at unit environment, however, 40% of the respondents from EGH ICU did so. Therefore, alter accepted temperature level by change setting of air conditioning according to persons desire was 0% in EGH ICU, mostly because setting board was not located in the unit, for any change they need to call air conditioning engineering department.

4.3.2.2 Hand washing

Regarding the hand washing as shown in table 4.34 just around 40% of both respondents from Shifa and EGH ICU adhered to hand washing protocols and guidelines. However, nearly 52% did not. The highest percentage of adherence was in the item of hand washing after touching blood or body fluids in the both groups (87%). In contrast, the lowest percentage of adherence were in the items of turn of water after hand washing using paper towel if elbow mixer not available (100%), washing hands for 15-30 seconds with soap and running water (100%), washing hands before touching the patients (98%), after removing gloves (100%) and use hand rub in area wherein hand washing sink is not accessible in percentage of (100%) but the last was because of unavailability of the hand rub material. However, the significant difference between respondents from Shifa and EGH ICU was in the item of hand washing before leaving the unit, the results indicated more commitment of EGH ICU nurses and physicians than Shifa, 92% for EGH ICU and 41.9% for Shifa ICU.

4.3.2.3 Personal protective equipment

As shown in table 4.43, 43.2% of the Shifa ICU nurses and physicians adhered to wear PPE which is considered an essential part to negate the risk of cross infection and to maintain the safety for both providers and patients. In contrast, significant positive difference was observed comparing with EGH ICU nurses and physicians practices (74%). Moreover, the correct worn and maintained of personal protective equipment as face mask and sterile gowns and the commitment to wear or use PPE when caring patients were the highest wide differences between the two site of working, nearly (94%) demonstrate the high commitment of HCPs to wear PPE in EGH ICU, versus 90% demonstrate the no commitment of HCPs to wear PPE in Shifa ICU .

4.3.2.4 Uniform

Regarding wearing uniform, considerable difference between commitment of nurses and physicians in Shifa and EGH ICU. 70% was observed to adhere wearing uniform in Shifa ICU and (50%) in EGH ICU. Although, swab cultures results of two different nurses and doctors in each ICUs in different point of time were contaminated with pathogenic bacteria. In addition, it is tormentor if knowing that all HCPs have to wash their own suit at their homes, because no laundry facilities available for them.

4.3.2.5 Handle laundry linens

Neither Shifa and EGH ICU nurses had a proper handling of laundry linens and other soft goods, that it is a pure nursing accountability, an average percentage of 70% of inappropriate implementations were observed without considerable difference between performance in the two site f working.

4.3.2.6 Instruments and Equipments

1. General Instruments and Equipments

The same as above, neither Shifa and EGH ICU nurses had implemented appropriate dealing with instruments and equipments in terms of cleaning and disinfecting, that it is a pure nursing accountability. And so, less than half about (42%) of nurses performance had appropriate dealing with instruments and equipments.

2. Equipments of patient airway management

Also this item is a pure nursing accountability because physicians in ICU are not accountable to care for inpatients airway, in which most of the patients are intubated and attached to mechanical ventilators. And so, nurses are accountable for that. However, 60% of them implemented appropriate dealing with equipments in terms of cleaning and disinfecting either in Shifa and EGH ICU. Therefore, suction tubes irrigation were not done by sterile water in a disposable cup neither in Shifa or EGH ICU. Particularly, using of sterile water in oxygen humidifier bottles and ventilator heated humidifier were done just in EGH ICU versus the unsatisfactory situation in Shifa ICU.

On the other hand, the majority of nursing practice (88%) toward soiled bottle cleaning and disinfecting before reuse were not correct. Thus, most of them instruct the cleaner to do so under their supervision. However, bottles were soaked in the available chlorine disinfectant for just moments. The researcher compared by swab culture results, between the previous act and the correct soaking time in the same usually available chlorine disinfectant regardless asking for concentration. 10 minutes soaking as CDC, 2008 recommendations for disinfectant use, was enough to have negative bacterial culture results versus the results of swab cultures for their usual act which were all positive.

3. Invasive procedures practices .

1. **Central Venous Catheter (CVC)**

   Regarding practices related to CVC, no significant difference between commitment of nurses and physicians in the two units. Unfortunately, 58% of them implemented improper practices toward CVC infection control. However, sterile towels were not available to maintain sterile field during the procedure in both units.

2. **Peripheral Venous Catheter(PVC)**

   On the subject of practices related to PVC, the same as CVC, most of nurses and physicians in the two site of working implemented improper practices toward PVC infection control. Relative increase of improper practices in Shifa (65%) than it was in EGH ICU. However, removal of PVC after 24 hr post admission from emergency room in emergency situations remained the highest inappropriate performance (100%), as it was not considerable at all.

3. **Intravenous (IV) Fluids and Medication**

   Respecting practices related to IV fluids and medication administration, this item is a pure nursing accountability because physicians in ICU are not accountable to administer fluids and medication as one of their routine daily work, adjacent to the accountability of nurses. And so, most of nurses (83.3%) applied incorrect infection control practices toward IV fluids and medication administration. For instance, no disinfection were performed for the port of insertion when using a multi dose vial in Shifa nor EGH ICU.

4. **Folly's catheter**

   Concerning infection control practices related to Folly's catheter indwelling and care. No major difference between commitment of nurses and physicians in Shifa and EGH ICU in term of maintaining sterility and pervert cross infection. Approximately 72.2 %, 59.3 % in Shifa and EGH ICU respectively practiced against infection control guidelines. Therefore, sterile towels were not available to maintain sterile field during insertion in both units. Also urine bags were not hanged on bed under the level of patients & above the floor, and outperformance of hand washing before catheter insertion in the two units represent high percentages of 75%, 100% respectively.

4.3.2.7 Use of antiseptics and disinfectant solutions

Regarding the proper use of antiseptic and disinfectant solutions, inconsiderable difference between performance of HCPs in Shifa and EGH ICU. Approximately, 50% commitment to proper use of antiseptic and disinfectant solutions were observed in the two units. However, time factor -in the perfect use of disinfectant- was the most ignored factor. For example, allowing skin to dry or dried by sterile gauze before beginning the invasive procedure when alcohol is used was the highest unimplemented performance (96%) among HCPs in the two units. The same as allowing Betadine to remain over skin 1-2 minutes before proceeding was nearly 72% among HCPs in the two units.

4.3.2.8 Healthcare waste disposal

On the subject of practices related to Healthcare waste disposal including sharp objects, insignificant difference between performance of HCPs in Shifa and EGH ICU was observed. In term of discarding waste properly, nearly 90% applied inappropriate performance, while better commitment toward sharp disposal in the two site of working was observed with a minor difference between performance of HCPs in Shifa that observations reported 58.1 % of accurate implementation, while HCPs in EGH ICU observations reported 72% of accurate implementation. However, recapping used needles reported the highest percentage (88%) for Shifa and (74%) for EGH ICU of this mistaken implementation because of the high risk of being injured. While, a significant difference in remove used needles from syringes before disposal was observed, that HCPs in EGH ICU observations reported 64% of this inaccurate implementation, in contrast with HCPs in Shifa ICU observations which give a better proportion of 74.7 % of perfect achievement.

4.4 Relationships between variables

4.4.1 Differences in personal and professional information and Dependent variable

Table 4.28: Relationship between knowledge and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Knowledge	Gender	20.76	0.188
	Age	34.20	0.362
	Marital status	16.54	0.416
	Profession	46.47	0.951
	Last degree awarded	32.41	0.959
	Current job position	105.53	0.030
	Total years of experience	27.25	0.706

The researcher used Chi-square test to examine the differences in the respondents answers due to their socio demographic characteristics: gender, age, marital status, profession, education, current job position and years of experience. Table 4.28 shows the differences in EIC knowledge and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors. The current finding of this study is consistent with a study conducted at Gaza by Abu Zaid, (2010) revealed that there is no statistical significant differences due to socio demographic factors.

Table 4.29: Relationship between Attitudes and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Attitudes	Gender	36.34	0.360
	Age	70.13	0.406
	Marital status	28.99	0.711
	Profession	140.73	0.373
	Last degree awarded	111.68	0.241
	Current job position	190.59	0.133
	Total years of experience	56.67	0.385

Table 4.29 shows the differences in EIC attitude and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors. The current finding of this study is consistent with a study conducted at Gaza.

Table 4.30: Relationship between Barriers and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Barriers that decrease HCPs commitment to EIC guidelines.	Gender	23.16	0.393
	Age	57.19	0.088
	Marital status	21.45	0.493
	Profession	86.64	0.523
	Last degree awarded	83.38	0.073
	Current job position	153.22	0.004
	Total years of experience	50.03	0.246

Table 4.30 shows the differences in Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors, except current job position.

Table 4.31: Relationship between Policies and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Policies	Gender	3.055	0.549
	Age	6.852	0.553
	Marital status	4.465	0.347
	Profession	15.87	0.462
	Last degree awarded	17.132	0.145
	Current job position	21.98	0.342
	Total years of experience	7.79	0.454

Table 4.31 shows the differences in knowledge about Policies of EIC and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors. The current finding of this study is consistent with a study conducted at Gaza

Table 4.32: Relation between education and training with socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Education and training	Gender	22.789	0.019
	Age	16.652	0.782
	Marital status	11.075	0.437
	Profession	48.832	0.285
	Last degree awarded	50.202	0.028
	Current job position	105.90	0.000
	Total years of experience	16.034	0.814

Table 4.32 shows the differences in EIC Education and training courses and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors except Current job position, gender and last degree awarded.

Table 4.33: Relationship between Vaccination and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Vaccination	Gender	1.717	0.944
	Age	16.542	0.168
	Marital status	3.502	0.744
	Profession	24.545	0.431
	Last degree awarded	60.933	0.000
	Current job position	60.321	0.001
	Total years of experience	17.663	0.126

Table 4.33 shows the differences in HCP response to vaccination and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors except Last degree awarded and current job position.

However, the current finding of this study is consistent with a study conducted in Germany by Wicker et al., (2010) which indicate that nurses had lower vaccination rates, were more likely to reject mandatory vaccinations, and were less likely to be convinced that vaccinations are important for them. With the exception of HBV vaccination, this result was found for influenza vaccination. This result could reflect a higher awareness among physicians regarding the benefits of vaccinations either for patients or for themselves. However, nurses usually have both closer and longer contact with patients than any other professional group of HCWs.

Moreover , the previous results are in line with those of a recently published study of a children's hospital in Kansas City, Missouri, in which most of the HCWs (70%) thought influenza vaccination should be mandatory for HCWs (Douville et al., 2010).

Table 4.34: Relationship between disease and injuries and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Disease and injuries	Gender	18.925	0.168
	Age	35.484	0.156
	Marital status	15.986	0.134
	Profession	54.667	0.525
	Last degree awarded	35.149	0.764
	Current job position	34.897	0.694
	Total years of experience	31.354	0.302

Table 4.34 shows the differences in EIC knowledge and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors. The current finding of this study is consistent with a study conducted at Gaza.

Table 4.35:Relationship between Auditing and supervision and socio demographic information

Dependent variable	Independent variable	Chi-square test	P-value(Sig).
Auditing and supervision	Gender	4.378	0.375
	Age	5.921	0.656
	Marital status	2.351	0.671
	Profession	17.563	0.351
	Last degree awarded	12.276	0.424
	Current job position	27.494	0.122
	Total years of experience	15.241	0.055

Table 4.35 shows the differences in EIC Auditing and supervision and socio demographic factors of the study population, the p-value (Sig.) is greater than the level of significance at $\alpha = 0.05$ for the all variables and then there is no significant differences in respondents' answers due to socio demographic factors, except total years of experience .

Table 4.36:
Independent Samples Test for the differences at the respondent at level α=0.05 between HCPs practices and knowledge

Field	Items	N	Mean	Std. Deviation	T	P-value
HCPs practices and knowledge	HCPs practices	68	0.4519	0.09910	1.423	0.157
	Knowledge	73	0.4281	0.09992		

Critical value of t at df "139" and significance level 0.05 equal 1.98

To test if there are significant differences on the respondent at level α=0.05 between health care providers practices and knowledge we use the Independent Samples Test and the result illustrated in table No 4.36 which show that the p-value equal 0.157 which is greater than 0.05 and the absolute value of T test equal 1.423 which is less than the value of critical value which is equal 1.98, that's means there is no significant differences on the respondent at level α=0.05 between health care providers practices and knowledge.

CHAPTER VI

Conclusions and Recommendations

5.1 Conclusions

Upon the application of Evaluation checklist "Fitness checklist".

- The study revealed that there is a percentage of 62% of the measures in Shifa were unfit. However, a little down percentage in EGH around 53%.
- Also, the total bacteria count in indoor air in ICU range from (1170 cfu/m^3 to 1470) cfu/m^3 in both ICU, however bacterial count shouldn't exceed 50-150 cfu/m3 According to Hong Kong indoor air quality management group.
- Moreover, the study reflect the presence of bacterial count which ranged from 73 to 90 in the inspired air from mechanical ventilation machines, however, fungal count was 830 cfc/m^3 in Shifa ventilator. In contrast with EGH mechanical ventilation machines which was free from fungal presence.
- Regarding climate temperature, the average were around 26.5^{o}C which is far than the standard that range from 21-24^{o}C according to WHO, (2003) and American Institute of Architect (AIA), (2001) in about 2^{o}C.
- In addition, the temperature level average during day hours was significantly greater far than the standards in about 4^{o}C.
- Concerning relative humidity level which was clearly at the high limit of the standards nearly 59% in both units (standard 60%).
- Concerning water quality,
- In spite of, count of total and fecal coliform in all water source in both ICUs were negative. water in ventilator heated humidifiers were positive cultured for presence of pathogenic bacteria in both ICUs, most likely the cause is improper disinfection for the humidifiers between patients.
- On the subject of environmental inanimate of surfaces, equipments and instruments, approximately all of environmental inanimate surfaces swabs were positive (96%).
- The pathogenic bacterial finding detected by swab culture distributed as *Pseudomonas* (38%), followed by *E-coli (32%)* and then *klebsilla* (16.5%) were the most common bacterial finding. However, *Staph arues(*16.1%) was detecting in EGH ICU and zero finding in Shifa ICU. Therefore, urgent interventions are required to improved methods of disinfecting the hospital environment inanimate surfaces.
- Swab cultures results of two different nurses and doctors uniform in each ICUs in different point of time were contaminated with pathogenic bacteria. In addition, it is tormentor if knowing that all HCPs have to wash their own suit at their homes, because no laundry facilities available for them.
- The highest unimplemented performance among HCPs in the two units was allowing disinfectant and antiseptic to have their recommended time to achieve the required cleaning.

Upon the evaluation of HCPs knowledge and attitude and practice toward environmental infection control.

- A total percentage of 66.2% of the participant answered improper answers in Shifa ICU, similar to the percentage of EGH ICU (70%).
- On the topic of knowledge about infection control policies, the study revealed that 85% of the participants were not familiar with these policies.
- Regarding education and training course the study revealed that 80% of the participant of the census study in both ICU of Shifa and EGH, had not been received any infection prevention & control training course. These results considered a good chance for improvement and development in this context.
- On the subject of auditing and monitoring programs, the study exposed that 54% of the participant saw that there was no auditing programs to ensure that policies have been implemented.
- Regarding vaccination, the study exposed that most of the participant nearly 78% are vaccinated against hepatitis B virus. In contrast, just about 5% were vaccinated against influenza virus in both ICUs.
- Concerning the frequencies of exposing to earn disease or to get injury during working, a total of approximately 45% of the study population exposed to disease and injuries.
- Moreover, more than half of the population in the two ICUs had earn chest infection that year, particularly 40% of them more than twice in the same year. On the other hand 73% of the HCPs acquire influenza that year, nearly 40% of them more than twice in the same year.
- The study indicate that all ICU HCPs in this census study had positive attitude toward EIC except in some items which need to improve their perception. For example, 64.66% of them doubted about removed of syringes from used needles before disposal **(t-value** 1.291 less than 2.0, **P-value** 0.201 more than 0.05).
- Many factors were determined by the participants as a obstacles in the way of EIC implementation. For instance, shortage of human resource reported the highest barrier (87.95%) followed by insufficient training and lack of knowledge and education regarding EIC (87.67%),
- lack of time and work overload which were the same as lack of supportive policy & auditing programs which reported 87.12%. Followed by Lack of materials and equipment regarding EIC 86%. And 85% considered the unavailability of aid nurse is an obstacle. While employee dissatisfaction reported 78%.
- Regarding performance, There was relatively more commitment of applied implementations among nurses than physicians in a difference percentage around 7.5% .
- However, about 50% of the nurses applied unhealthy implementations. Particularly, IV fluids and medication administration and healthcare waste disposal were the highest poor implementations among nurses.
- However, physicians unhealthy performances in terms of central and peripheral venous catheter (PVC) ranged above 60%, and healthcare waste disposal still the highest malpractices reported among physicians also.
- Otherwise, adherent of all HCPs to wear personal protective equipment was the most significant difference between Shifa (43.2%) and EGH ICU (74%)

5.2 Recommendation

Away from the darkness of infection, and in the light of the study results, and the above-mentioned conclusions the researcher would emphasize many useful recommendations that may help in promoting the improvement of environmental infection control measures and HCPs commitment.

- More coordination is acquired between air conditioning engineering department and infection control committee in hospitals. Therefore, regular maintenance of HEPA filters is required, in order to evaluate the efficiency of the filters against pathogenic microbes and to detect the exactly number of total air change. For example, minimum total air change is at least six air exchanges per hour (ACH) in ICU.
- Urgent coordination with medical equipment engineering department to solve the problem in mechanical ventilators machines, which were contaminated in approximately huge number of bacterial and fungal pathogens particularly in Shifa hospital, thus mechanical ventilators machines in EGH ICU were free from fungal pathogens but not from bacteria.
- Palestinian infection control protocol need to be updated to include standards about air and ventilation system, particularly bacterial and fungal count in indoor air. Also standards for climate temperature average in ICU is required.
- Urgent interventions are required to improved methods of disinfecting the hospital environment inanimate surfaces.
- Time factor need to be more considerable in the perfect use of disinfectant. Thus,
- The study finding support the pre-enrichment method over the direct culture on solid agars to avoid overlooking potential pathogens which exist in low numbers but still impose risk.
- Further Education and training courses regarding infection prevention & control need to be conducted to increase the HCPs knowledge about policies and environmental infection control, in addition to motivate more compliance.
- Auditing and monitoring programs are advised to be more assertive to ensure that policies have been implemented.
- Regarding vaccination the researcher recommend to add the influenza vaccine for all HCPs working in ICUs, in order to reduce the negative impact on immune compromised patients and the days of sick leaves. Thus,73% of the HCPs acquire influenza in 2012, nearly 40% of them more than twice in the same year.
- Hand rub need to be available as alternative of hand washing especially in areas that hand cleaning is frequent required as ICUs.
- Aid nurse could be a magic solution to decline cross infection by enhance registered nurse accountability and allow them to concentrate on technical jobs by utilizing their expertise to its fullest benefit and prevent nurses to spend unnecessarily long time doing nursing assistants' tasks.
- Irrigation containers post suctioning procedures should be disposable as it was incorrect habit in both ICUs against procedure policy, particularly most HCPs had the attitude of use disposable irrigation container but there was no restricted policy.
- More auditing programs and restricted policies are required to increase commitment of applied implementations among physicians, that they were less compliance.

- Vital system and implementations for healthcare waste disposal need to be assume that it remained the highest malpractices reported in the two site of the study.
- Clean uniforms for HCPs should be worn each shift, and not worn outside the unit. Washing of uniforms should be hospital responsibility, to stop HCPs washing their own suit at their homes, in order to negate public hazards.

5.2.1 Recommendations for further research

- Further research should be done to update the PIPC to include standards of microbial air count, and water quality. Also standards for climate temperature average in ICUs is required.

- More research should be done to detect the exactly number of total air change per hour.

- More research to evaluate the efficiency of HEPA filters against pathogenic microbes inside the air ventilation tracts.

- Conducting similar research at the specialist ICUs in the hospitals.

- Further research to assess the consequences of earn diseases and needle stick injuries on the health of the HCPs.

- Advance research to evaluate the effect of mechanical ventilators machines (which were contaminated in approximately huge number of bacterial and fungal pathogens) on the patients under MV treatment.

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Annex No.1 Approval of IUG

بسم الله الرحمن الرحيم

الجامعة الإسلامية – غزة
The Islamic University - Gaza

قسم البيئة و علوم الأرض – كلية العلوم – الجامعة الإسلامية – غزة

الرقم..... Ref

التاريخ..... Date
التاريخ : 17 / 9 / 2012

السيد الدكتور/ناصر ابو شعبان..... حفظه الله
مدير ادارة تنمية القوى البشرية بوزارة الصحة الفلسطينية

السلام عليكم و رحمة الله و بركاته ،،،

الموضوع : تسهيل مهمة باحث ماجستير

نهديكم في قسم البيئة و علوم الأرض أطيب التحيات و نرجو التكرم بالعلم بأن الطالب / **خالد جمال أحمد** **خضورة** يحتاج إلى جمع معلومات و أخذ عينات ضمن رسالة الماجستير الخاصة به و المعنونة بـ

"EVALUATION OF ENVIRONMENTAL INFECTION CONTROL AT THE INTENSIVE CARE UNITS IN GAZA GOVERNORATES"

علما بأن الطالب المذكور أعلا هو طالب في برنامج ماجستير العلوم البيئية شعبة صحة البيئة ، لذا نرجو من سيادتكم مساعدة الطالب المذكور أعلاه من أجل البحث العلمي لا غير.

و تقبلوا فائق الاحترام و التقدير،،،

أ. سهير حرارة
رئيس قسم البيئة و علوم الأرض

ENVIRONMENT & EARTH SCIENCE DEPARTMENT

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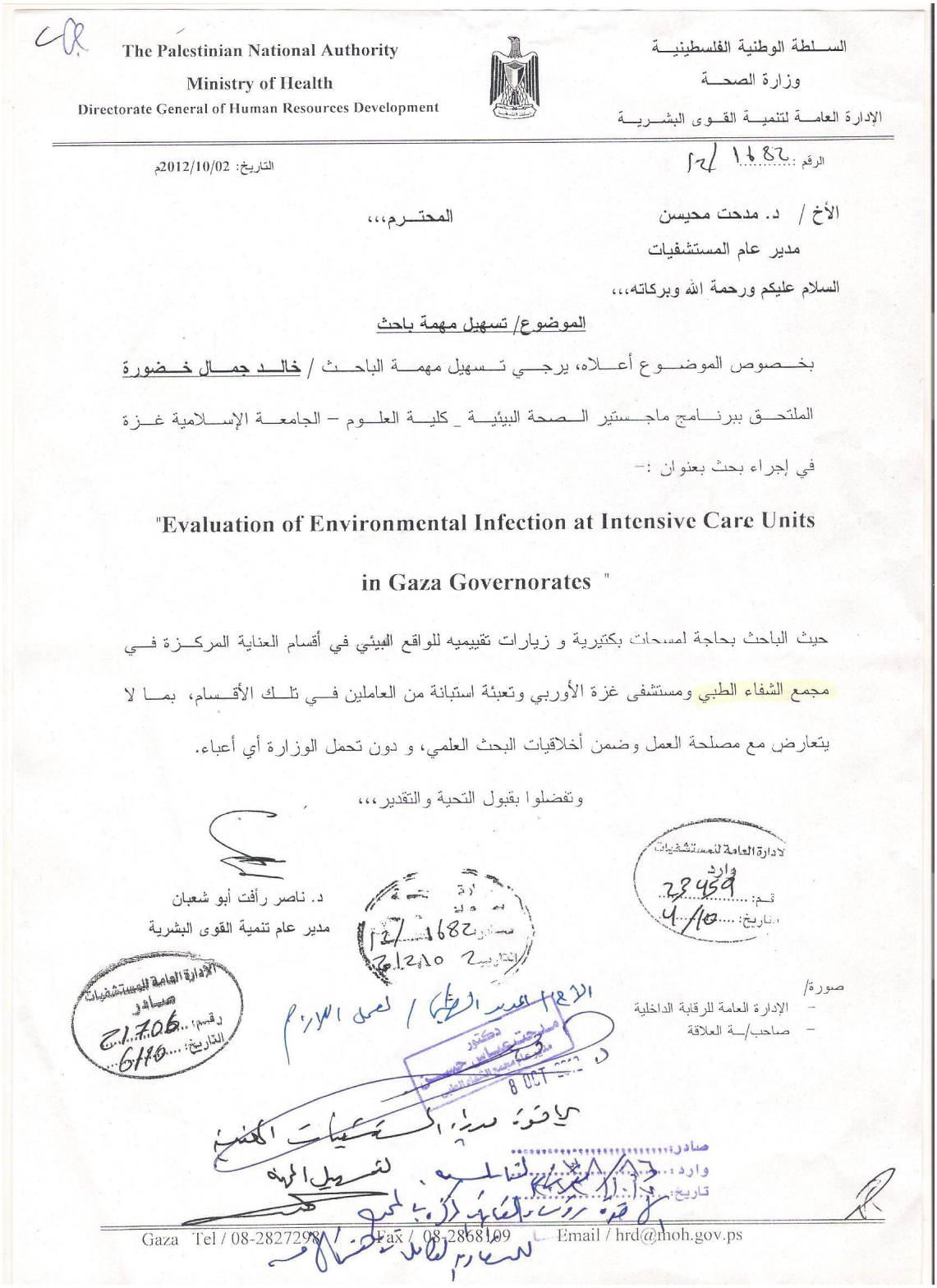
Annex No.2 Approval of MOH



The Palestinian National Authority
Ministry of Health
Directorate General of Human Resources Development

السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة لتنمية القوى البشرية

الرقم: 1682/12
التاريخ: 2012/10/02م

الأخ / د. مدحت محيسن
مدير عام المستشفيات

المحترم،،،

السلام عليكم ورحمة الله وبركاته،،،

الموضوع/ تسهيل مهمة باحث

بخصوص الموضوع أعلاه، يرجي تسهيل مهمة الباحث / خالد جمال خضورة الملتحق ببرنامج ماجستير الصحة البيئية _ كلية العلوم – الجامعة الإسلامية غزة في إجراء بحث بعنوان :-

"Evaluation of Environmental Infection at Intensive Care Units in Gaza Governorates "

حيث الباحث بحاجة لمسحات بكتيرية و زيارات تقييميه للواقع البيئي في أقسام العناية المركزة في مجمع الشفاء الطبي ومستشفى غزة الأوربي وتعبئة استبانة من العاملين في تلك الأقسام، بما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، و دون تحمل الوزارة أي أعباء.

وتفضلوا بقبول التحية والتقدير،،،

د. ناصر رأفت أبو شعبان
مدير عام تنمية القوى البشرية

الإدارة العامة للمستشفيات
وارد
رقم: 2845
التاريخ: 4/10

صورة/
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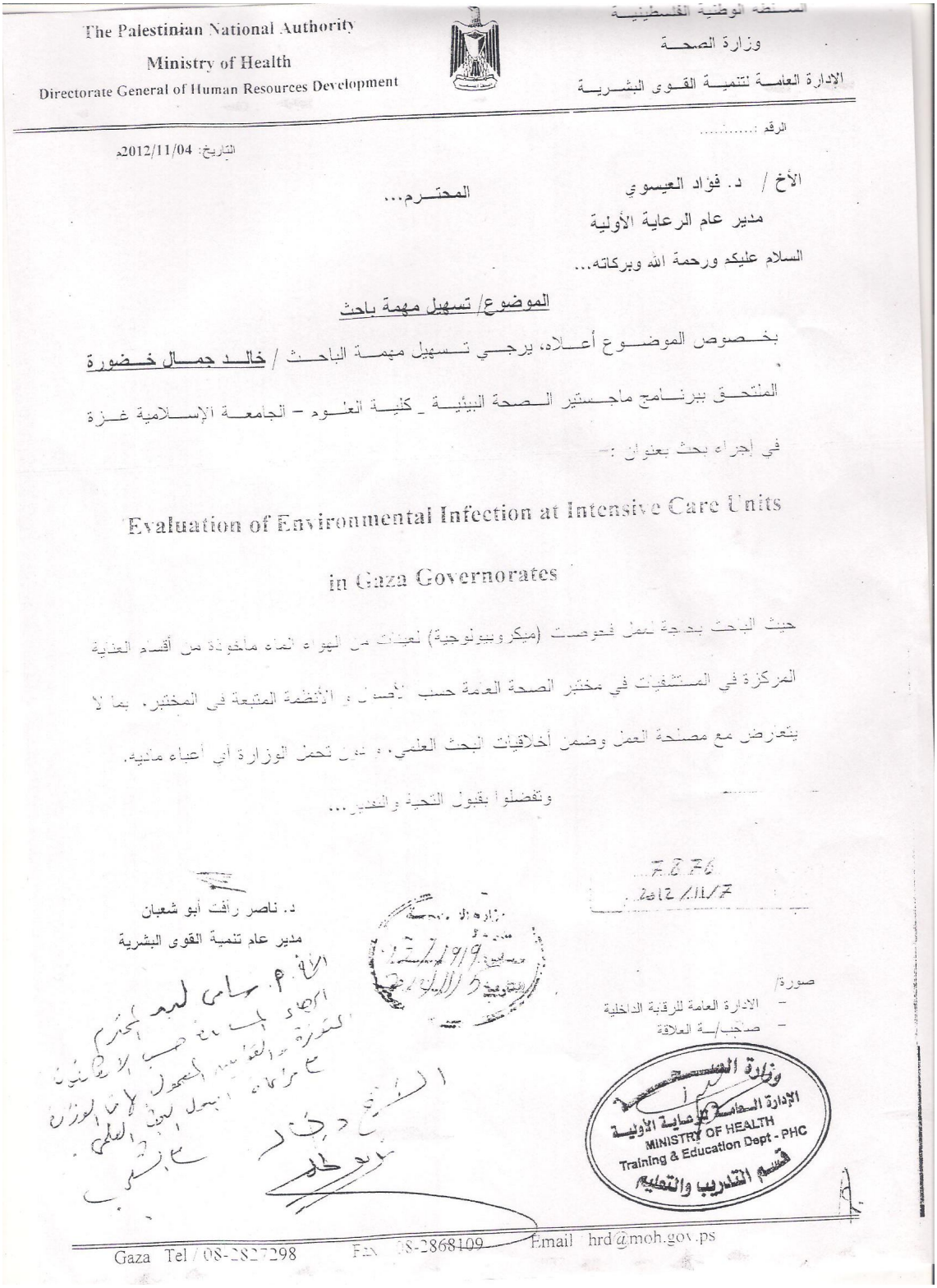
Gaza Tel / 08-2827298 Fax / 08-2868109 Email / hrd@moh.gov.ps

Annex No.3 Approval of Public Health Lab.



السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة لتنمية القوى البشرية

The Palestinian National Authority
Ministry of Health
Directorate General of Human Resources Development

الرقم: .....
التاريخ: 2012/11/04م

المحترم...

الأخ / د. فؤاد العيسوي
مدير عام الرعاية الأولية

السلام عليكم ورحمة الله وبركاته...

الموضوع/ تسهيل مهمة باحث

بخصوص الموضوع أعلاه، يرجى تسهيل مهمة الباحث / خالد جمال خضورة
الملتحق ببرنامج ماجستير الصحة البيئية _ كلية العلوم – الجامعة الإسلامية غزة
في إجراء بحث بعنوان :-

Evaluation of Environmental Infection at Intensive Care Units in Gaza Governorates

حيث الباحث بحاجة لعمل فحوصات (ميكروبيولوجية) لعينات من الهواء الماء مأخوذة من أقسام العناية المركزة في المستشفيات في مختبر الصحة العامة حسب الأصول و الأنظمة المتبعة في المختبر. بما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، دون تحمل الوزارة أي أعباء مادية.

وتفضلوا بقبول التحية والتقدير...

د. ناصر رأفت أبو شعبان
مدير عام تنمية القوى البشرية

صورة/
- الادارة العامة للرقابة الداخلية
- صاحب/ـة العلاقة

وزارة الصحة
الإدارة العامة للرعاية الأولية
MINISTRY OF HEALTH
Training & Education Dept - PHC
قسم التدريب والتعليم

Gaza Tel / 08-2827298 Fax 08-2868109 Email hrd@moh.gov.ps

Annex No.4 Approval of Helsinki committee

Palestinian National Authority
Ministry of Health
Helsinki Committee

السلطة الوطنية الفلسطينية
وزارة الصحة
لجنة هلسنكي

التاريخ: **3/12/2012**

Name: **Khalid Khadoura**

الاسم: خالد خضورة

I would like to inform you that the committee has discussed your application about:
"Evaluation of environmental infection control at Intensive Care Units in Gaza Governorates".

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:-

In its meeting on **December 2012**
and decided the Following:-
To approve the above mention research study.

و ذلك في جلستها المنعقدة لشهر **12 2012**
و قد قررت ما يلي:-
الموافقة على البحث المذكور عاليه.

Signature
توقيع

Member
عضو

Member
عضو

Chairperson

Conditions:-
- Valid for 2 years from the date of approval to start.
- It is necessary to notify the committee in any change in the admitted study protocol.
- The committee appreciate receiving one copy of your final research when it is completed.

Annex No.5 Site of samples collection

Shifa intensive care unit

Annex No.6

Measurements of Temperature, Shifa Hospital ICU

No.	Date and Day	Time	Temperature					
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1	**Saturday 20/10/2012**	2pm	29.5	29.4	29.6	29	29.5	29.2
		8pm	28.1	28	28	28.3	28.5	28
2	**Sunday 21/10/2012**	7am	27.6	26.2	26.4	26.6	27.5	26.3
		2pm	27.6	27.5	27.3	27.5	27.5	26.6
		8pm	27.5	27.2	27.5	27.4	27.3	27
		12mn	24.7	24.9	24	24	24.8	-
3	**Wednesday 24/10/2012**	8am	27.4	27.5	27.3	27.4	27.4	26.4
		2pm	29	28.4	28.5	28.4	28.5	27.5
		8pm	27.4	27.3	27.5	27.4	27.5	27.3
		12mn	24.7	23.9	24	24	24.8	-
4	**Saturday 28/10/2012**	8am	27.6	27.2	27.4	27.6	27.5	27.3
		2pm	27.6	27.5	27.3	27.5	27.5	27.6
		8pm	27.5	26.2	27.5	26.4	27.3	27
5	**Tuesday 30/10/012**	8am	28.6	27	27.3	27.5	28.4	27.4
		2pm	29.5	29.4	29.6	29	29.5	29.2
		12mn	24.7	23.9	24	24	24.8	24.9
		6am	26.8	25.8	26	26.7	26.3	-
	Range		27.5	27.4	27.5	27.6	27.3	27.8

Measurements of Relative Humidity, Shifa Hospital ICU

No.	Date and Day	Time	Relative humidity					
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1	**Saturday 20/10/2012**	2pm	57	55	55	54	55	66
		8pm	57	56	57	55	57	60
2	**Sunday 21/10/2012**	7am	65	63	66	63	64	64
		2pm	65	68	64	64	66	64
		8pm	60	61	60	62	62	63
		12mn	58	57	58	58	57	-
3	**Wednesday 24/10/2012**	8am	55	53	54	54	55	55
		2pm	54	54	56	53	55	54
		8pm	54	55	54	55	53	54
		12MN	58	57	58	58	57	-
4	**Saturday 28/10/2012**	8am	65	63	66	63	64	64
		2pm	65	68	64	64	66	64
		8pm	60	61	60	62	62	63
5	**Tuesday 30/10/012**	8am	58	57	58	60	56	64
		2pm	57	55	55	54	55	66
		12MN	58	57	58	58	57	57
		6am	58	58	59	59	57	-
	Range		59	58.7	58.9	58.6	58.7	61.2

Annex No.7

Measurements of Temperature, EGH ICU

No.	Date and Day	Time	Temperature					
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1	**Monday 22/10/2012**	7am	27.6	27	27.3	27.5	27.4	27.4
		1pm	28.4	28.3	28.4	28.5	28.4	28.5
2	**Thursday 25/10/2012**	8am	27.6	27	27.3	27.5	27.4	27.4
		2pm	29.5	29.4	29.6	29	29.5	29.2
		12mn	23.7	23.9	24	24	23.8	-
		6am	21.8	21.8	22	22.7	22.3	22.1
3	**Sunday 28/10/2012**	12md	27.1	27	27.1	27.1	27	27.2
		6pm	24.6	24.5	24.8	24.7	24.5	24.6
		8pm	26.5	24.9	26.2	24.3	24.1	25
		12mn	23.7	23.9	24	24	23.8	23.9
		6am	21.8	21.8	22	22.7	22.3	22.1
4	**Monday 29/10/2012**	12md	27.1	27	27.1	27.1	27	-
		6pm	24.6	24.5	24.8	24.7	24.5	24.6
		8pm	26.5	24.9	26.2	24.3	24.1	25
		12mn	23.7	23.9	24	24	23.8	23.9
		6am	21.8	21.8	22	22.7	22.3	22.1
5	**Wednesday 31/10/2012**	12md	27.1	27	27.1	27.1	27	-
		6pm	24.6	24.5	24.8	24.7	24.5	24.6
		8pm	26.5	24.9	26.2	24.3	24.1	25
		12mn	23.7	23.9	24	24	23.8	23.9
		6am	21.8	21.8	22	22.7	22.3	22.1
	Range		25.2	24.9	25.2	25.1	24.9	25

Measurements of Relative Humidity, EGH ICU

No.	Date and Day	Time	Relative humidity					
			Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
1	**Monday 22/10/2012**	7am	58	57	58	60	54	64
		1pm	64	65	63	62	64	68
2	**Thursday 25/10/2012**	8am	58	57	58	60	56	64
		2pm	57	55	55	54	55	66
		12mn	58	57	58	58	57	-
		6am	58	58	59	59	57	58
3	**Sunday 28/10/2012**	12md	60	56	60	60	58	58
		6pm	61	62	62	61	60	61
		8pm	58	57	59	58	57	58
		12mn	58	57	58	58	57	57
		6am	58	58	59	59	57	58
4	**Monday 29/10/2012**	12md	60	56	60	60	58	-
		6pm	61	62	62	61	60	61
		8pm	58	57	59	58	57	58
		12mn	58	57	58	58	57	57
		6am	58	58	59	59	57	58
5	**Wednesday 31/10/2012**	12md	60	56	60	60	58	-
		6pm	58	57	58	60	54	64
		8pm	64	65	63	62	64	68
		12mn	58	57	58	60	56	64
		6am	57	55	55	54	55	66
	Range		25.2	58	57	58	58	57

Annex No.8 Water microbiological report, Shifa ICU

PALESTINIAN NATIONAL AUTHORITY
Ministry of Health
General Administration of P.H.C
Public Health Laboratory

السلطة الوطنية الفلسطينية
وزارة الصحة
الادارة العامة للرعاية الأولية
مختبر الصحة العامة

WATER MICROBIOLOGY REPORT تقرير فحص ميكروبيولوجي مياه شرب

Code No.	16/12/2012	الرقم السري	Sample source:	بحث خالد خضورة	مصدر العينة
Area :	غزة - م. الشفاء	المنطقة :	Date of sampling	11/12/2012	تاريخ الاستلام
Collect by:	خالد خضورة				اسم آخذ العينة وجهة العمل :
					ملاحظـــات :
	محمد سعدة				اسم الفاحص :

نتائج الفحص (Colony / 100ml)

No.	Sourec of sample	Total Coliform	Fecal Coliform	Fecal Strepto.	*Pseudomonas aerruginosa/250ml*	*Staph Aureus*
1	مياه فلتر	Neg	Neg		Neg	
2	مياه فلتر	Neg	Neg		Neg	
3	مياه من حوض التعقيم	Neg	Neg		Neg	
4	مياه من حوض التعقيم	Neg	Neg		Neg	

التاريخ : 13/12/2012

رئيس القسم :.....

مدير المختبر :.....

سامي حسين لبد
مدير مختبر الصحة العامة

* المختبر مسئول عن نتائج العينات الواردة للمختبر فقط .
* لايجوز إعادة إصدار التقرير إلا بموافقة خطية من مدير المختبر .
* المختبر حاصـــل على شهـــــادة اعتماد المختبـــــرات .(PSI 17)

PLAC

Annex No.9 Water microbiological report, EGH ICU

PALESTINIAN NATIONAL AUTHORITY
Ministry of Health
General Administration of P.H.C
Public Health Laboratory

السلطة الوطنية الفلسطينية
وزارة الصحة
الادارة العامة للرعاية الأولية
مختبر الصحة العامة

WATER MICROBIOLOGY REPORT تقرير فحص ميكروبيولوجي مياه شرب

Code No.	07/12/2012	الرقم السري	Sample source:	بحث خالد خضورة	مصدر العينة
Area :	المستشفى الاوروبي	المنطقة :	Date of sampling	03/12/2012	تاريخ الاستلام
Collect by:	خالد خضورة				اسم آخذ العينة وجهة العمل :
					ملاحظـــات :
	ياسر البيومي				اسم الفاحص :

نتائج الفحص (Colony / 100ml)

No.	Sourec of sample	Total Coliform	Fecal Coliform	Fecal Strepto.	*Pseudomonas aerruginosa/250ml*	*Staph Aureus*
1	مياه خزان	Neg	Neg		Neg	
2	مياه فلتر	Neg	Neg		Neg	

التاريخ : 10/12/2012

رئيس القسم :.....

سامي حسين ابو سمرة
مدير مختبر الصحة العامة
مدير المختبر :.....

* المختبر مسئول عن نتائج العينات الواردة للمختبر فقط .
* لايجوز إعادة إصدار التقرير إلا بموافقة خطية من مدير المختبر .
* المختبر حاصـل على شهـــادة اعتماد المختبـــرات .(PSI 17)

PLAC

Annex No.10 Names of Expert Panel

1. Dr. Abed Roof El Manama
   Islamic university of Gaza, Doctor of Microbiology

2. Dr. Nasser Abo El Noor
   Islamic university of Gaza, Doctor of Public Health

3. Dr. Abed EL Kareem Rdwan
   Islamic university of Gaza, Doctor of Mental Health

4. Dr. Nafez M. Barakat
   Islamic university of Gaza, Doctor of Statistics

5. Mr. Mohammed El Hawamda
   Jordan infection control senior, Operation Room Head Nurse

6. Mr. Ismail Thabet
   Shifa hospital, Head Nurse of Sterilization Department

Annex No.11 Walk around infection control checklist

INFECTION CONTROL WALK AROUND

Hospital :_____ Department: _____ Date: from / /20 to / / 20
Compliance %:

All questions can be answered with Yes (Y), No (N) or Not applicable (X)

PROCESS: OBSERVATION

I	**AIR AND VENTILATION SYSTEM** **Heating, Ventilation, and Air Conditioning Systems in ICU**	**yes**	**no**	**x**	**Q#**
1	Temperature level average (21- 24)^{0}C is appropriate				
2	Windows and doors need to keep closed as much as possible				
3	The standards of air ventilation system for infection is met. (minimum total air change is at least six air exchanges per hour)				
4	HEPA (High efficiency particulate air) filters are well function				
5	Ventilation grills are dusts free.				
	Total scores				
	Comments:				
II	**WATER QUALITY AND HAND WASHING**	**yes**	**no**	**x**	**Q#**
6	Available water is high quality (no visible pollution indicator as verdigris or deposited materials)				
	HAND WASHING FACILITIES **Standard: Hands will be washed correctly, using an available cleansing agent.**	**yes**	**no**	**x**	**Q#**
7	Liquid soap is available at all sinks in a special container				
8	No soaked instruments in sink area.				
9	Paper towels are available at all sinks.				
10	Access to hand washing sinks is clear.				
11	Hand washing poster is available.				
12	Elbow operated mixer tap are available in the sinks.				
13	Hand rub is available in area wherein hand washing sink is not accessible				
	Total scores				
	Comments:				
III	**PERSONAL PROTECTIVE EQUIPMENT** **Standard: Personal protective equipment (PPE) is correctly worn and maintained to negate the risk of infection/cross infection.**	**yes**	**no**	**x**	**Q#**
14	The following PPE is available for use by staff				
15	Non-sterile and/or sterile gloves				
16	Plastic disposable aprons, clean non-sterile gowns, sterile gowns				
17	Eye protection, face shields				

18	Masks (surgical mask/N95 mask)				
	Total scores				
	Comments:				
IV	**CARE OF EQUIPMENT** **Standard: Equipment will be cleaned/decontaminated appropriately and stored correctly to negate the risk of infection.**	**yes**	**no**	**x**	**Q#**
19	Chairs, tables and lockers are clean and in a good state of repair.				
20	Suction equipment is clean and dry. Catheter is not attached (clean cover acceptable in some emergency areas).				
21	Oxygen humidifier is kept dry when not in use/date on when used.				
22	Thermometers are stored dry.				
23	Bed frames are clean and free from excessive dust				
24	Routine cleaning is done regularly.				
25	Items of sterile equipment are in date (randomly select two items and check date).				
	Total scores				
	Comments:				
V	**ENVIRONMENT** **Standard: The unit environment will be maintained appropriately to negate the risk of cross infection.**				
	PATIENT UNIT	**yes**	**no**	**x**	**Q#**
26	The unit is clean, organized and dust free.				
27	Patient bed is with clean sheet.				
28	The unit is free from inappropriate items of equipment.				
29	The walls, ceiling, sinks & waste containers are disinfected periodically according to schedule				
30	Dressing trolleys are clean and in good state or repair.				
31	All antiseptic solutions are in date.				
32	Horizontal surfaces are free of dust				
33	The floor is covered with antistatic material.				
34	The floor is cleaned & disinfected thoroughly during the day & regularly when get dirty.				
35	with impervious, antistatic paint washable The walls should be painted and impervious to moisture .				
36	A rigid puncture resistant sharp container is available/not full.				
	Comments:				
	SHOWER ROOM	**yes**	**no**	**x**	**Q#**
37	Bathrooms are clean/free from communal items i.e. bath soaps, etc.				
38	Bed bath basin, liquid soap and paper towels are available.				
39	All lifting aides are waterproof and easy to clean (e.g bath seats, commodes, etc).				
40	The bath has been cleaned following patient use				
41	Bath trolley is kept clean and dry.				

42	Garbage bin is covered with appropriate plastic bag				
	Comments:				
	TOILETS	**yes**	**no**	**x**	**Q#**
43	Toilet and surrounding area is clean and free from extraneous items				
44	Hand wash basin, liquid soap and paper towels are available				
45	Garbage bin is covered with appropriate plastic bag.				
	Comments:				
	UTILITY ROOM	**yes**	**no**	**x**	**Q#**
46	Clean and soiled utility areas are separated				
47	Space and ventilation is adequate				
48	External shipping cartons are removed				
49	Stock is rotated				
50	Cleaning supplies are appropriately stored				
	Comments:				
	Total scores of ENVIRONMENT				
VI	**MEDICATIONS/SUPPLIES** **Standard: Medications and supplies are checked regularly and stored appropriately to prevent the risk of cross infection**	**yes**	**no**	**x**	**Q#**
51	No expired patient care supplies				
52	Patient care supplies stored appropriately.				
53	No expired medication.				
54	Current mechanism to check monthly expired patient care supplies				
55	Current multiuse bottles and vials discarded according to manufacturer's expiration date.				
56	0.9%NS and sterile water discarded 24 hours after opening.				
57	Single dose vials discarded 24 hours after each use				
	Total score				
	Comments:				
VII	**REFRIGERATORS** **Standard: Refrigerators should be logged daily to ensure proper temperature readings to negate the risk of infection.**	**yes**	**no**	**x**	**Q#**
58	Labeled appropriately				
59	Thermometer present.				
60	Temperature is logged daily.				
61	Appropriate items are stored				
62	Appropriate action is done when temperature not adequate.				
63	Alarm is on when appropriate				
VIII	**ANTISEPTIC, DISINFECTION AND STERILIZATION (IF PERFORMED)**	**yes**	**no**	**x**	**Q#**
64	Appropriate PPE is used.				
65	Space and ventilation is appropriate				
66	Workflow is acceptable.				
67	Approved disinfectant is used				

68	Containers are labeled with expiration date				
69	Appropriate packaging is used				
70	Time and event related disinfectant and sterility policy is followed				
71	Biological or chemical indicators are used per policy				
72	Ethyl alcohol 70% is available as antiseptic.				
73	Alcohol swap container is kept closed when not in use				
74	Betadine 10% is available as antiseptic.				
75	Chlorine used for floor disinfectant in concentration of 1000 per million (20ml Chlorine 5% in 1 letter water)				
76	Blood spots are cleaned by paper or tissue towels for absorbent that disposed immediately then disinfected by another towel with high concentration disinfectant (chlorine 5000 per million)				
	Total scores				
	Comments:				
IX	**HANDLING OF CONTAMINATED EQUIPMENT**	**yes**	**no**	**x**	**Q#**
77	PPE is used to protect from splashes of blood and body fluid.				
78	Non-sharp items dried with paper towels or cloth.				
79	All contaminated items placed in orange plastic bag marked contaminated and handled with gloves				
80	Gross soiling from itmes removed prior to sending to CSSD by rinsing under cold running water				
	Total scores				
	Comments:				
X	**STORAGE**	**yes**	**no**	**x**	**Q#**
81	No storage above 18-20 inches from the ceiling.				
82	No storage below 8-10 inches from the floor.				
83	Shipping boxes not present.				
84	No storage of clean items in biohazard bags.				
85	Space and ventilation is adequate.				
86	Items must be protected against dust, moisture, insects and extremes of temperature and humidity.				
	Total scores				
	Comments:				
XI	**WASTE DISPOSAL** **Standard: Waste is disposed of safely without risk of contaminated or injury.**	**yes**	**no**	**x**	**Q#**
87	Correct seggregation of wastes: domestic, infectious and cytotoxic.				
88	Waste bags are disposed of at 2/3 full, securely sealed and labeled.				
89	Foot operated bins in working order for clinical wastes.				
90	Waste bags stored safely, away from the public.				

91	The storage area is cleaned regularly.				
92	Containers properly sealed prior to disposal				
93	Persons handling wastes wear heavy gloves & closed shoes.				
94	Materials post infected dressing are collected in a bag and closed well				
	Total scores				
	Comments:				
	SHARPS HANDLING AND DISPOSAL **Standard: Sharps will be handled safely to negate the risk of sharps injury.**	**yes**	**no**	**x**	**Q#**
95	Sharps immediately disposed into a puncture resistant sharp containers.				
96	Sharp box is less than 2/3 full/sealed before disposing.				
97	Sharp box is free from protruding sharps.				
98	Sharp box is located in appropriate areas.				
99	Easily accessible/not blocked				
100	The filled sharp containers sent to incinerator.				
101	The surrounding environment is clean.				
	Total scores				
	Comments:				
XII	**LINEN HANDLING AND DISPOSAL** **Standard: Linen is handled appropriately to prevent cross infection.**	**yes**	**no**	**x**	**Q#**
102	Dirty linen is disposed in nylon bag.				
103	Soiled linen is disposed in a water-soluble bag and then double nylon bag				
104	Bags are less than 2/3 full and are capable of being secured				
105	Bags are stored in the dirty utility/linen				
106	Clean linens are stored in a clean area (not in the dirty utility/bathroom).				
107	**Mattresses and Pillows** Bed mattress and pillows are covered with moisture-resistant cover as the first layer and the second layer is soft cotton cover.				
108	Bed mattress and pillows are clean and free from wet spots**.**				
109	No sign of needle sticking in bed mattress and pillows.				
110	Launder pillow covers & washable pillows are washed between patients or when they become contaminated with body substances.				
111	Clean and disinfected moisture-resistant mattress covers are changed between patients.				
	Total scores				
	Comments:				
XIII	**CONSTRUCTION/RENOVATION (if applicable)**				
112	There is an infection control review of plans				
113	Dust barriers are present and intact.				
114	Signage is in place.				
115	Traffic is rerouted				

	Total scores				
	Comments:				
	TOTAL FOR ALL SECTIONS (I- XIII)	**yes**	**no**	**x**	**Q#**
A	Total # of Yes =				
B	115 minus (# of X's) =				
	Overall Rating = A / B x 100% =				

Annex No. 12 Evaluation chick list "fitness checklist"

Hospital :…… **Department:** **Date: / /2012**

No.	Item			
	Air and ventilation system **Airborne Infectious Diseases in ICUs**			
			Around standard	
1	Total fungi count in indoor air in ICU	count	**yes**	no
2	Total bacteria count in indoor air in ICU			
3	Total fungi count in indoor storage room air in ICU			
4	Total bacteria count in indoor storage room air in ICU			
5	Total fungi count in indoor isolation room air in ICU			
6	Total bacteria count in indoor isolation room air in ICU			
7	Total fungi count in indoor laundry room air in ICU			
8	Total bacteria count in indoor laundry room air in ICU			
9	Presence of fungi in mechanical ventilator inspired air			
10	Presence of bacteria in mechanical ventilator inspired air			
11	**Heating, Ventilation, and Air Conditioning Systems in ICU** **Temperature** Temperature level average (21- 24)			
12	Temperature level average (21- 24) in storage rooms			
13	**Humidity** Humidity level average (30-60)%			
14	Humidity level average (30-60)% in storage rooms			
15	**Ventilation and Filtration** Availability of HEPA (High efficiency particulate air) filters			
16	HEPA filters are available in the isolation room with positive pressure.			
17	There is more than one isolation room in the unit.			
18	**Pressurization** Availability of negative pressure			
	Water quality and hand washing **Waterborne infectious disease in ICU**			
19	Count of total coliform in tap water.	**+, -**	**yes**	no
20	Count of total coliform in drinking water			
21	Count of total coliform in water from disinfectant basin.			
22	Count of fecal coliform in tap water.			
23	Count of fecal coliform in drinking water.			
24	Count of fical coliform in water from disinfectant basin			
25	Presence of *pseudomonas* in tap water .			
26	Presence of *pseudomonas* in drinking water			
27	Presence of *pseudomonas* in water from disinfectant basin			
28	Presence of pathogenic bacteria in ventilator heated humidifier water.			
29	**Hand washing facilities** Liquid soap is available at all sinks in a special container			
30	No soaked instruments in sink area.			

31	Paper towels are available at all sinks.		
32	Access to hand washing sinks is clear.		
33	The sinks are free from used equipment e.g. soaked instruments.		
34	Hand washing poster is available.		
35	Elbow operated mixer tap are available in the sinks.		
36	Hand rub is available in area wherein hand washing sink is not accessible.		
	Environmental surface cleaning		
37	The floor is covered with antistatic material.	**yes**	no
38	The floor is cleaned & disinfected thoroughly during the day & regularly when get dirty.		
39	The walls should be with impervious, antistatic paint washable painted and impervious to moisture.		
40	Chair, tables, telephone & nursing counter. should be clean, free from dust & disinfected daily.		
41	The walls, ceiling, sinks & waste containers are disinfected periodically according to schedule		
42	Water tap, sinks are disinfected daily & regularly when get dirty.		
43	Bath room and Toilet have been cleaned following patients use.		
44	All sterile product are stored above floor level, no storage below 8-10 inches from floor.		
45	No storage above 18-20 inches from ceiling.		
46	Space and ventilation is adequate in storage rooms.		
47	Items are protected against dust, moisture, insects and extremes of temperature and humidity in storage rooms.		
48	Thermometer present in storage room.		
	Dealing with Instruments and Equipments		
49	Medical instruments are sterile and in a good state of use.(dressing sets, central line sets). (culture will be done to detect infectious pathogens)	**yes**	no
50	Medical equipments (monitors, ventilators , infusion pumps, syringe pumps) are clean, disinfected & free from dust. (culture will be done to detect infectious pathogens)		
51	Resuscitation equipments are clean, disinfected and free from dust (Ambu bag, mask & laryngoscope). (culture will be done to detect infectious pathogens)	**yes**	no
52	Availability of sterile and non- sterile gloves.		
53	Availability of eye protection.		
54	Availability of plastic disposal aprons.		
55	Availability of sterile and non sterile gowns.		
56	Availability of surgical masks / N95 mask.		
57	Oxygen humidifier is kept dry when not used.		
58	Suction bottle is kept dry and clean when not used.		
59	Bed frames and side rails are clean, free from dust.		
60	Bed bath basin are clean and available.		
61	Bath trolley is disinfected after each use.		
62	Dressing trolley is disinfected after each use.		
	Laundry		
63	**Linen** Special bags are available for dirty linen.	**yes**	no
64	Water-soluble bags are available for soiled linen to be disposed by		

	another double bags.		
65	Labels are available for soiled linens.		
66	Bags are less than 2/3 full and are capable to being secure.		
67	Clean linens are stored in a clean area (not in the dirty utility /bathroom).		
68	**Mattresses and Pillows** Bed mattress and pillows are covered with moisture-resistant cover as the first layer, however soft cotton cover is the second layer.		
69	Bed mattress and pillows are clean and free from wet spots**.**		
70	No sign of needle sticking in bed mattress and pillows.		
71	Clean and disinfected moisture-resistant mattress covers are available to be changed between patients.		
	Healthcare waste **Goal: Waste is disposed of safely without risk of contamination or injury**		
72	Correct segregation of waste: domestic, infectious, and cytotoxic	**yes**	no
73	The three colored bags for segregation of waste is available.		
74	Waste bag are disposed of at 2/3 ful .		
75	Persons handling wastes wear heavy gloves & closed shoes.		
76	Materials post infected dressing are collected in a bag and closed well		
77	**Sharps disposal** **Goal : Sharps are handled safely to negate the risk of sharps injury** Puncture resistant sharp containers are available.	**yes**	no
78	Sharp containers properly sealed prior to disposal.		
79	Sharp box is less than 3/4 full before disposing.		
80	Easily accessible /not blocked.		
81	Sharp box is located in appropriate areas .		
82	There is sharp disposal container in each unit.		
83	The filled sharp containers sent to incinerator.		
84	The surrounding environment is clean.		
	Antiseptic and disinfection		
85	Ethyl alcohol 70% is available as antiseptic.	**yes**	no
86	Alcohol swap container is kept closed most of the time when not in use		
87	Betadine 10% is available as antiseptic.		
88	Chlorohexidine is available as antiseptic.		
89	Chlorine used for floor disinfectant in concentration of 1000 per million (20ml Chlorine 5% in 1 letter water)		
90	Space and ventilation is appropriate when disinfectant used.		
91	Blood spots are cleaned by paper or tissue towels for absorbent that disposed immediately then disinfected by another towel with high concentration disinfectant (chlorine 5000 per million)		

Annex No. 13

Questionnaire

please answer the following questions:

1- Personal and professional information

Hospital :_____ Department: _____ Serial number ___ Date: / / 2012

1	Gender	1. Male 2. Female
2	Age in years	---------- years
3	Marital status	1. Single 2. Married 3. Divorced 4. Widow/er
4	Profession	1. Specialist physician 2. General physician 3. RN Nurse 4. Diploma nurse 5. Physiotherapist
5	Last degree awarded	1. Diploma 2. Bachelor 3. Master 4. PhD 5. Other (specify) ------
6	Current job position	1. Head of department 2. Head nurse 3. Head of department assistant 4. Head nurse assistant 5. Practitioner 6. Nurse supervisor
7	Total years of experience ---------- years	

2- Up to your knowledge, please answer the following questions by tech (X) in the appropriate box of the following :

1- yes 2- no

8	**Policies** Do you know if there is a Palestinian infection prevention and control protocol?	yes	no
9	Is there a copy of the Palestinian infection prevention & control (PIPC) protocol in the department?	yes	no
10	Have you seen it before (PIPC) ?	yes	no
11	Have you read it before (PIPC)?	yes	no
12	Does hospital management adopt policies and regulations to support the compliance to the PIPC protocols?	yes	no
13	**Education and training** Have you received any infection prevention & control training course ?	yes	no
14	Have you received any lecture about Air & ventilation system in ICU?	yes	no
15	Have you received any lecture about infection prevention & control in ICU?	yes	no
16	Does your basic education curriculum incorporate training about the infection control protocols and guidelines?	yes	no
17	Does your hospital provide in- service training	yes	no

	and education about infection control protocols and guidelines?			
18	If yes, does the provided training improve your performance?		yes	no
19	**Vaccination** Have you vaccinated for hepatitis B?		yes	no
20	If yes , how many doses?	1. one	2. two	3.three or more
21	Have you ever vaccinated for influenza?		yes	no
22	If yes , how many years did you receive the vaccine ?	1. one	2. two	3. three
23	**Disease and injuries** Have you get any chest infection this year ?		yes	no
24	If yes , how many times ?	1. one	2. two	3.three or more
25	Have you get influenza this year ?		yes	no
26	If yes , how many times ?	1. one	2. two	3.three or more
27	Have you get any urinary tract infection this year ?		yes	no
28	If yes , how many times ?	1. one	2. two	3.three or more
29	Have you been exposed to any injury from used needle or sharp surgical instrument ?		yes	no
30	**Auditing and supervision** Is there an infection control committee in your hospital ?		yes	no
31	Does hospital management encourage the practices of the PIPC protocols?		yes	no
32	Is there an auditing program to ensure that policies have been implemented?		yes	no
33	Has your facility ever carried out a follow up / supervision of your practice regarding the infection prevention implementation?		yes	no

Up to your knowledge, Please record the level of your agreement or disagreement with each of the following statement by tech (X) in the appropriate box of the following

1.**Yes 2. No 3. Don't know dk .**

	Item	yes	no
34	**Air & ventilation system** The suitable temperature level in ICU is (16-20)		
35	The suitable humidity level in ICU is (50 -70)%		
36	In positive pressure areas, filtration efficiency should be at 90 percent efficiency in the supply airstream and return at 99.97% for a 0.3 µm sized particle.		
37	In negative pressure areas filtration efficiency should be at 99.97 percent efficiency for a 0.3 µm sized particle in the supply airstream and return is none required .		
38	Negative pressure is needed for immunocompromised patients in isolation rooms.		
39	Windows and doors need to be opened as much as possible.		
40	Minimum total air change per hour is equal or more than 3 air change per hour (ACH) in isolation rooms.		
41	Differential pressure of positive pressure for immunocompromised patients isolation rooms is > - 8 Pa.		

42	**Water quality and hand washing** Hand rub is the most proper way for infection control.		
43	Elbow operated mixer tap need to be available in the sinks.		
44	Hand rub need to be available in area wherein hand washing sink is accessible.		
45	**Environmental surfaces** The floor should be covered with antistatic material.		
46	Walls should be disinfected periodically according to schedule.		
47	All sterile product are stored above floor level, no storage below 100 cm from floor		
48	Storage should not be above 100 cm from ceiling.		
49	**Instruments and Equipments** Oxygen humidifier should not changed between patients.		
50	Medical equipment as monitors, ventilator, infusion pumps and syringe pumps should not be disinfected daily & between patients because of working by electricity.		
51	Monitors cables should not be disinfected daily & between patients to keep from damage.		
52	**Suctioning of sputum secretion** Suction bottle should kept dry when not used		
53	Disinfectant solution would be used to irrigate suction tubes		
54	Irrigation container should be disposable		
55	**Laundry, Linen** Soiled linen should be disposed in a water-soluble bags.		
56	Soiled linens should not be labeled.		
57	**Laundry , Mattresses and Pillows** Bed mattress and pillows should be covered with moisture-resistant as the first layer, however soft cotton cover is the second layer.		
58	Needles should not be stick into the mattress through the cover.		
59	Clean and disinfect moisture-resistant mattress covers should replaced between patients.		
60	**Medical waste management** Correct segregation of waste should be in two bags.		
61	Waste bag should disposed of at complete full .		
62	**Sharp disposal** Used needles should be removed from syringes before disposal.		
63	Used needles should be bended prior disposal.		
64	Sharp box should less than 1/2 full before disposing .		
65	**Disinfection and Sterilization** Chlorine used for floor disinfectant should be in concentration of 1000 per million (20ml Chlorine 5% in 1 liter water)		
66	Chemical indicator for sterility not so important.		
67	Paper indicator for sterility is so important .		
68	Blood spots should not be cleaned by paper or tissue towels for absorbent that disposed immediately then disinfected by another towel with normal concentration disinfectant (chlorine 1000 per million)		
69	Instruments should be soaked in disinfectant for 10 minutes before send to sterilization		
70	The laryngoscope should be sterilized after each use.		

3- Up to your Attitudes, Please record the level of your agreement or disagreement with each of the following statement by tech (X) in the appropriate box of the following :

1.**Strongly disagree 2. Disagree 3. Undecided 4. Agree 5. Strongly agree**

	Item	1	2	3	4	5
71	**Air & ventilation system** Windows and doors should kept closed as much as possible.					
72	The standards of air ventilation system for infection control in your unit is met (minimum total air change is at least six air exchanges per hour ACH).					
73	Temperature level average in your unit is satisfactory					
74	Your provided care is affected negatively by unsatisfactory temperature level average in your unit					
75	**Water quality and hand washing** Hand washing is not the most proper way for infection control.					
76	Available water is high quality (no visible pollution indicator as verdigris or deposited materials)					
77	Hand rub need to be alternative of hand washing					
78	**Environmental surfaces** The floor should be covered with ceramic.					
79	Glove use for all patients is a useful strategy for reducing risk of surgical site infection.					
80	Sterile items will not be affected from dust, moisture, insects and extremes of temperature and humidity in storage rooms.					
81	**Instruments and Equipments** Monitors, ventilator, infusion pumps, syringe pumps and prepared suction bottles should be clean, free from dust & disinfected daily & between patients by nurse.					
82	Monitors cables should be clean, free from dust & disinfected daily & between patients by nurse.					
83	Bed frames should be clean, free from dust and disinfected daily & between patients by nurse .					
84	**Suctioning of sputum secretion** Suction catheter should be attached after doing suction to be ready for second suction .					
85	Suction bottle are disinfected in satisfactory manner for reuse					
86	Sterile water should be use for suction tubes irrigation post each suctioning procedure					
87	Irrigation container should be disposable					
88	**Laundry , linen** Soiled linen should be disposed in a water-soluble bag then double plastic bagged.					
89	Soiled linens should be labeled					
90	**Mattresses and Pillows** Mattress and pillow covers should not be replace if they become torn or otherwise in need of repair.					
91	Mattresses should kept dry & should be discard if they become and remain wet or stained.					
92	**Medical waste** Correct segregation of waste: domestic, infectious, and cytotoxic should done					

93	**Sharp disposal** Used needles should not be removed from syringes before disposal.					
94	Used needles should not be recapping prior disposal.					
95	**Cleaning aids "disinfection and sterilization".** Instruments are brushed well before soaked in disinfectant.					
96	Instruments are not need to allowed to dry before sterilization.					
97	The laryngoscope and anesthesia instrument should be cleaned with disinfectant solution after each use.					

4- Barriers that decrease HCPs commitment to environmental infection control (EIC) guidelines.

Up to your opinion, please answer the following questions by tech (X) in the appropriate box of the following :

1.**Strongly disagree 2. Disagree 3. Undecided 4. Agree 5. Strongly agree**

	Item					
98	Unsuitable design and infrastructure of the ICU to environmental infection control (EIC) .					
99	Lack of materials and equipment regarding EIC.					
100	Lack of knowledge and education regarding EIC.					
101	Insufficient training regarding EIC.					
102	Difficult to understand in spite of lectures and training.					
103	Employee dissatisfaction.					
104	Lack of time and work overload.					
105	The shortage of human resource.					
106	Unavailability of aid nurse					
107	Lack of supportive policy & auditing programs .					
108	No accountability and feedback from administration.					
109	Lack of guidelines from colleague and superior.					

Annex No. 14

Practice observation check list for HCPs

Hospital :_____ Department: _____ Serial number ___ Profession ___

No.	Item	First reading		Second reading		Third reading	
		Applied	Not	Applied	Not	Applied	Not
1	**Keeping air quality at unit environment** Windows and doors are kept closed as much as possible						
2	Alter accepted temperature level by change setting of air conditioning according to persons desire.						
3	**Hand washing** Immediately on arrival to the unit						
4	Before touching the patients.						
5	After working with patients.						
6	Before leaving the unit.						
7	Before performing a septic invasive procedures.						
8	After touching blood or body fluids.						
9	Before wearing gloves.						
10	After removing gloves.						
11	Removing jewelry, hand watch, and ring when washing hands.						
12	Washing hands for 15-30 seconds with soap and running water						
13	Drying hands with clean paper towel if avaliable						
14	Turn of water after hand washing using paper towel. If elbow mixer not available						
15	Use Hand rub in area wherein hand washing sink is not accessible						
16	**Uniform** All health care providers wear uniform during duty.						
17	Clean uniforms are available every shift for everyone of staff members						
18	**Personal protective equipment (PPE) and Wearing gloves** Personal protective equipment is correctly worn and maintained to negate the risk of infection /cross infection (face mask, sterile gowns)						
19	Commitment to wear or use PPE when caring patients.						
20	Wearing sterile gloves in appropriate way.						
21	Wear gloves when contact with blood or other body fluids.						
22	Use clean gloves when handling contaminated instrument.						
23	Remove gloves in proper way						
24	**Handle laundry linens in proper way** Dirty linen is disposed in special bag.						
25	Soiled linen is disposed in a water-soluble bag then double bagged.						
26	Soiled linens are labeled.						

27	Bagged are less than 2/3 full and secured well.						
28	**Mattresses and Pillows** Keep mattresses dry; discard them if they become and remain wet or stained.						
29	Clean and disinfect mattress covers using disinfectants, if available, that are compatible with the cover materials to prevent the development of tears, cracks, or holes in the cover.						
30	Replace mattress and pillow covers if they become torn or otherwise in need of repair.						
31	Do not stick needles into the mattress through the cover.						
32	Clean and disinfect moisture-resistant mattress covers are changed between patients.						
33	**Dealing with Instruments and Equipments** Medical instruments are cleaned and disinfected between patients in proper way. (dressing sets, central line sets).						
34	Monitors cables are clean, free from dust & disinfected daily & between patients. (culture will be done to detect infectious pathogens)						
35	Soiled blood pressure cuff should be clean & disinfected between patients.						
36	Patient unit (monitors, ventilators , infusion pumps, syringe pumps) are clean & free from dust. (culture will be done to detect infectious pathogens						
37	Medical equipment is disinfected after use. (dressing trolley , Ambu bag, mask & laryngoscope)						
38	Bed frames are disinfected daily & between patients.						
39	Wash basins are disinfected on a regular basis by using approved disinfectant as set by policies.						
40	**Instruments and Equipments of patient airway management**. Breathing tubes are changed if became soiled or malfunction for the same patient						
41	Breathing tubes are changed between patients						
42	Using sterile water in oxygen and heated humidifier.						
43	Oxygen humidifier is changed between patients						
44	Suction bottle are changed or evacuated every 24hr.						
45	Soiled bottle are cleaned and disinfected properly before reuse. (culture will be done to detect infectious pathogens)						
46	Irrigation for suction tubes are done by sterile water in a disposable cup.						
47	**Instruments and Equipments of invasive procedures.** **Central Venous Catheter(CVC)** Done under aseptic technique.						
48	Scraping or surgical hand washing done before insertion catheter.						
49	Sterile towels are available to maintain sterile field.						
50	Mask, cap, and sterile gloves and gown must be worn for insertion.						
51	Sterility is maintained during and after samples collection.						
52	**Peripheral Venous Catheter (PVC)** Wear latex gloves before PVC insertion						
53	Done under aseptic technique.						

54	Removed after 24 hr post admission from emergency room						
55	Change of dressing on **(PVC)** performed daily.						
56	Replace PVC every 72 hours or when malfunction before 72 hrs.						
57	Date of insertion is written on PVC						
58	**IV fluids and medication** Disinfection performed when using a multi dose vial.						
59	Multi dose vial labeled with the name, date, time of preparation. & concentration of dilution						
60	Multi dose vials are kept in fridge after dilution for next dose use.						
61	Intravenous lines of solutions given by infusion or syringe pump are changed every 72 hours						
62	Intravenous lines are changed after the transfusion of blood or intralipids, and for discontinuous perfusions.						
63	Intravenous lines of Central Venous pressure CVP manometer are changed every 72 hours						
64	**Folly's Catheter** Scraping or surgical hand washing done before insertion catheter.						
65	Done under aseptic technique.						
66	Sterile towels are available to maintain sterile field.						
67	Sterility is maintained during and after samples collection.						
68	Urine bag is hanged on bed under the level of patients & above the floor						
69	**Use of antiseptics and disinfectant solutions** Sterile field is established and maintained during procedures.						
70	Ethyl alcohol (70%) swap is used to clean the skin by gently scrubbing before invasive procedures.						
71	Skin is allowed to dry or dried by sterile gauze before beginning the invasive procedure when alcohol is used.						
72	Betadine is allowed to remain over skin 1-2 minutes before proceeding						
73	Instruments are brushed well before soaked in disinfectant.						
74	Instruments are soaked in chlorine disinfectant 0.5% for 10 minutes before send to sterilization or as manufacture instruction for other disinfectant solutions.						
75	Instruments are allowed to dry before send to sterilization.						
76	**Medical waste management** **Discarding waste and sharp disposal properly** Segregation of infectious waste in any proper way as possible.						
77	Suction catheter is disposed properly after doing suction .						
78	**Sharp disposal** Do not remove used needles from syringes before disposal.						
79	Do not bend or break used needles prior disposal.						
80	Do not recap used needles.						
81	Dispose all sharps in puncture resistance containers.						

Annex No. 15

الجامعة الإسلامية – غزة

كلية الدراسات العليا

برنامج ماجستير الصحة البيئية

استبانة

عزيزي المشارك

يسعدني جدا مشاركتك في هذا البحث العلمي بعنوان **تقييم مكافحة العدوى البيئية في وحدات العناية المركزة في محافظات قطاع غزة.**

هذا البحث متطلب جزئي للحصول على درجة الماجستير في الصحة البيئية من الجامعة الإسلامية-غزة ، كلية الدراسات العليا، تخصص صحة البيئة، وهو ممول ذاتيا من الباحث.

تهدف هذه الدراسة إلى تقييم وسائل مكافحة العدوى البيئية في وحدات العناية المركزة في محافظات قطاع غزة، وملائمة هذه الوسائل للمعايير العالمية وكذلك تقييم معرفة و توجهات العاملين في أقسام العناية المركزة من أطباء وتمريض وأخصائيين علاج طبيعي حول مكافحة العدوى البيئية.

الوقت اللازم لتعبئة الاستبانة لا يتجاوز خمسة عشر دقيقة، مع العلم أن المشاركة في هذه الاستبانه اختيارية، و لك حق الانسحاب في أي لحظة. جميع المعلومات المقدمة سوف تستخدم لغرض البحث العلمي فقط مع ضمان السرية التامة، ولا داعي لكتابة الاسم على الاستبانه.

يرجى الإجابة على جميع الأسئلة بحسب معرفتك الشخصية وما تراه مناسبا، مع العلم انه لا يوجد أراء صحيحة وأخرى خاطئة، سوف أكون جاهزا لأي استفسار أثناء تعبئة البيانات.

أثمن عاليا استجابتكم للمشاركة وأشكركم جزيل الشكر

الباحث / خالد جمال خضورة

جوال رقم/0599189117

1- المعلومات الشخصية والمهنية

المستشفى ـــــــــــــ القسم ـــــــــ الرقم التسلسلي ـــــــــــــ التاريخ / / 2012

1	الجنس	1- ذكر 2- أنثى
2	العمر	سنة
3	الحالة الاجتماعية	1- أعزب 2 -متزوج/ة 3 -مطلق/ة 4-أرمل /ة
4	المهنة	1- طبيب أخصائي 2 -طبيب عام 3 -حكيم 4- ممرض دبلوم 5- أخصائي علاج طبيعي
5	أخر شهادة علمية حصلت عليها	1- دبلوم 2 -بكالوريوس 3 -ماجستير 4- دكتوراه 5- خرى
6	الوظيفة الحالية	1- رئيس القسم 2 -نائب رئيس القسم 3- رئيس تمريض القسم 4- نائب رئيس تمريض القسم 5 - مشرف تمريض 6-موظف بدون صفة إدارية
7	سنوات الخبرة	سنة

2- من فضلك اجب عن هذه الأسئلة بوضع إشارة x أمام احد هذين الخيارين : نعم أو لا.

8	**الأنظمة والقوانين** هل تعرف إذا كان يوجد بروتوكول فلسطيني لمنع ومكافحة العدوى أم لا ؟		1- نعم	2- لا
9	هل يوجد نسخة من بروتوكول منع ومكافحة العدوى في القسم الذي تعمل به ؟			
10	هل سبق وان رأيته؟			
11	هل سبق وان اطلعت على محتوياته؟			
12	هل طورت إدارة المستشفى الذي تعمل به قوانين تدعم الالتزام بمنع ومكافحة العدوى ؟			
13	**التعليم والتدريب** هل تلقيت أي دورات تدريبية في مجال مكافحة العدوى؟			
14	هل تلقيت أي محاضرات حول البيئة الهوائية و نظام التهوية في القسم؟			
15	هل اشتمل المنهاج التعليمي في الدرجة الجامعية الأولى على تدريبات حول مكافحة العدوى ؟			
16	هل تلقيت أي محاضرات حول وسائل مكافحة العدوى ؟			
17	هل تقدم المستشفي دورات تعليم داخلية لمنع ومكافحة العدوى في المستشفى؟			
18	إذا كانت الإجابة نعم، هل حسنت هذه الدورات من مستوى أداءك؟			
19	**التطعيمات** هل تلقيت تطعيم ضد التهاب الكبد الوبائي ب؟			
20	إذا كانت الإجابة نعم، كم كان عدد الجرعات؟	1- واحدة	2- اثنتان	3- ثلاثة
21	هل تلقيت تطعيم ضد الأنفلونزا ؟		1- نعم	2- لا
22	**إذا كانت الإجابة نعم، كم كان عدد السنوات التي تلقيت فيها الجرعات؟**	1- واحدة	2- اثنتان	3- ثلاثة أو أكثر
23	**الأمراض والإصابات** هل أصبت بأي التهابات في الجهاز التنفسي هذا العام؟		1- نعم	2- لا

24	إذا كانت الإجابة نعم، كم كان عدد المرات؟	1- واحدة	2- اثنتان	3- ثلاثة أو أكثر
25	هل أصبت بانفلونزا هذا العام؟		1- نعم	2- لا
26	إذا كانت الإجابة نعم، كم كان عدد المرات؟	1- واحدة	2- اثنتان	3- ثلاثة أو أكثر
27	هل أصبت بأي التهابات في المسالك البولية او الجهاز التناسلي هذا العام؟		1- نعم	2- لا
28	إذا كانت الإجابة نعم، كم كان عدد المرات؟	1- واحدة	2- اثنتان	3- ثلاثة أو أكثر
29	هل تعرضت للوخز بإبرة أو أي أداة جراحية بعد استخدامها مع المريض؟		1- نعم	2- لا
30	**المراقبة والإشراف** هل يوجد لجنة لمنع ومكافحة العدوى في المستشفى ؟			
31	هل تشجع إدارة المستشفي تطبيق وسائل منع ومكافحة العدوى ؟			
32	هل يوجد أي نظام مراقبة للتأكد من تطبيق القوانين الخاصة بمنع ومكافحة العدوى ؟			
33	هل يتم الإشراف على أداءك بالنسبة لمنع العدوى من قبل لجنة متخصصة ؟			

بناء على معلوماتك، الرجاء تسجيل مدى موافقتك على هذه العبارات بوضع إشارة x أمام احد هذه الخيارات

1- نعم 2- لا 3- لا اعرف

الرقم	العبارة	نعم	لا	لا اعرف
34	**البيئة الهوائية و نظام التهوية** درجة الحرارة المناسبة في غرف العناية المركزة من 16-20 درجة مئوية			
35	معدل الرطوبة المناسبة في غرف العناية المركزة من (50- 70) %			
36	في المناطق المطلوب فيها ضغط هواء موجب، يجب أن يدخل الهواء بمعدل فلترة يصل إلى 90 %، ويخرج بمعدل فلترة يصل إلى 99.97 % .			
37	في المناطق المطلوب فيها ضغط هواء سالب، يجب أن يدخل الهواء بمعدل فلترة يصل إلى 99.97 % ، و لا يخرج .			
38	المناطق المطلوب فيها ضغط هواء سالب هي غرف العزل للمرضى أصحاب المناعات الضعيفة.			
39	يجب فتح الأبواب و الشبابيك قدر الإمكان لضمان تغيير الهواء في وحدة العناية المركزة.			
40	المستوى الأدنى لمعدل تغير الهواء في غرف العزل هو3 مرات في الساعة الواحدة			
41	فارق الضغط في غرف العزل المطلوب فيها ضغط هواء موجب للمرضى ذوات المناعات الضعيفة هو أكثر من (- 8 بار)			
42	**جودة المياه و غسل الأيدي** يعتبر فرك الأيدي بالكحول الهلامي أفضل الطرق لمكافحة العدوى			
43	من الضروري وجود خلاط ماء على المغاسل يتم التحكم به بمرفق اليد			
44	نحتاج فرك الأيدي بالكحول الهلامي في المناطق التي يتوفر فيها مغسلة .			
45	**الأسطح البيئية** يجب أن تغطى الأرض بمادة عازلة			

46	الجدران يجب أن تطهر من فترة إلى آخرة بحسب جدول خاص				
47	جميع الأدوات المعقمة يجب ان تخزن فوق مستوى سطح الأرض بما لا يقل عن متر				
48	المسافة اللازمة للتخزين بالقرب من السقف هي أكثر من متر				
49	**المعدات و الأدوات** لا يجب استبدال مرطب الأكسجين بين المرضى				
50	لا يجب تطهير الأجهزة في وحدة المريض يوميا لأنها تعمل بالكهرباء				
51	كوابل شاشة المراقبة يجب أن لا تطهر يوميا وبين المرضى حتى لا تعطب.				
52	**أدوات التشفيط الرغامي** مرطبان الشفط يجب أن يبقى جاف في حال عدم الاستخدام				
53	لعمل غسيل لأنبوب الشفط بعد كل عملية شفط يفضل استخدام محلول مطهر				
54	ينبغي عدم استخدام نفس الحاوية التي تحتوي على محلول الغسيل لأنبوب الشفط				
55	**الغسيل** الملايات المتسخة يجب ان تجمع في حاويات تمتص السوائل.				
56	لا يجب وضع ملصقات على حاويات جمع الملايات المتسخة				
57	**الفرشات والمخدات** يجب ان تغطى بوجه قطني ثم وجه بلاستيكي مقاوم للرطوبة و يمكن تطهيره.				
58	لا يجب وخز الفرشات بالابر				
59	يجب تغيير الوجه البلاستيكي بعد خروج المريض.				
60	**النفايات الطبية** يمكن فصل النفايات الطبية بشكل صحيح باستخدام عبوتين مختلفتين				
61	يجب أن تملا عبوات جمع النفايات تماما				
62	**النفايات الطبية الحادة** يجب فصل السرنج عن الابرة المستخدمة قبل التخلص منها في الصندوق الامن				
63	يجب ثني الابرة قبل التخلص منها لضمان عدم وخز الآخرين				
64	يجب التخلص من الصندوق الآمن وهو نصف ممتلئ				
65	**وسائل التطهير والتعقيم** للتطهير الارضيات الدوري يجب ان يكون تركيز الكلور 0.5% وذلك باضافة 20مللتر كلور 5% الى لتر ماء				
66	ليس بالضروري استخدام مؤشرات التعقيم الكيميائية				
67	ولكن من الضروري استعمال مؤشرات التعقيم الورقية				
68	للتطهير الأرضيات من بقع الدم يجب ان يكون تركيز الكلور0.5 % وذلك باضافة 20مللتر كلور 5% الى لتر ماء				
69	الادوات يجب ان تترك مغموسة في السائل المطهر لمدة عشر دقائق قبل غسلها وارسالها للتعقيم				
70	المنظار الرئوي يجب ان يعقم بعد كل مريض.				

بناء على توجهاتك، الرجاء تسجيل مدى موافقتك على هذه العبارات بوضع إشارة x أمام احد هذه الخيارات
1- معارض بشدة 2 - غير موافق 3- محايد 4- موافق 5- موافق بشدة

الرقم	العبارة	معارض بشدة	غير موافق	محايد	موافق	موافق بشدة
71	**البيئة الهوائية و نظام التهوية** ينبغي ان نحافظ على الأبواب والنوافذ مغلقة قدر الإمكان					
72	معايير نظام التهوية لمكافحة العدوى في القسم مناسبة (على الأقل يتم تغير الهواء في الوحدة 6مرات في الساعة)					
73	معدل درجة الحرارة في القسم مرضي					
74	العناية المقدمة للمريض تتأثر سلبيا مع معدل درجة الحرارة الغير مرضي في القسم					
75	**جودة المياه و غسل الأيدي** لا يعتبر غسل الأيدي هو الطريقة الأمثل لمكافحة العدوى					
76	الماء المتوفر للعناية بالمريض عالي الجودة (لا توجد علامات تلوث ظاهرة مثل الصدأ و الرسوبيات الملحوظة)					
77	فرك الأيدي بالكحول الهلامي يجب ان يكون بديل لغسل الأيدي حتى في حال توفر الماء والصابون					
78	**الاسطح البيئية** يجب أن تكون الأرضيات من الكراميكا					
79	استخدام القفازات لجميع المرضى هي استراتيجية مفيدة لمكافحة العدوى					
80	لا تؤثر زيادة الرطوبة على الادوات المعقمة في المخزن					
81	**المعدات والادوات** يجب تطهير الاجهزة مثل جهاز التنفس الصناعي وشاشة المراقبة واجهزة التحكم بالمحلول وغير ذلك يوميا وبين المرضى وذلك بواسطة التمريض					
82	يجب تطهير كوابل شاشة المراقبة يوميا وبين المرضى وذلك بواسطة التمريض					
83	يجب تطهير حواف الاسرة وتنظيفها بواسطة التمريض					
84	**أدوات التشفيط الرغامي** يجب الحفاظ على انبوبة الشفط متصلة بجهاز الشفط بعد عملية الشفط لتكون جاهزة للاستخدام التالي					
85	عملية تطهير مرطبان الشفط المستخدم تجرى بطريقة صحيحة و مرضية لإعادة استخدامه					
86	ينبغي استخدام ماء معقم لغسل أنبوب الشفط بعد كل عملية شفط					
87	ينبغي أن تكون الحاوية التي تحتوي على محلول الغسيل لأنبوب الشفط أحادية الاستخدام					
88	**الغسيل** الملايات المتسخة يجب ان تجمع في حاويات تمتص السوائل ثم حاويات بلاستيكية					
89	يجب وضع ملصقات على حاويات جمع الملايات المتسخة					
90	**الفرشات والمخدات** يجب تغيير الوجه البلاستيكي للفرشات والمخدات اذا احتاج اصلاح.					
91	يجب الحفاظ على الفرشات جافة والتخلص منها اذا لم يمكن التخلص من رطوبتها					
92	**النفايات الطبية** يجب فصل النفايات الطبية في ثلاث مجموعات (النفايات المنزلية، النفايات المعدية ، النفايات السامة)					
93	**النفايات الحادة** يجب عدم فصل السرنج عن الإبرة المستخدمة قبل التخلص منها في الصندوق الامن					

94	يجب التأكد من إعادة إغلاق الإبرة قبل التخلص منها					
95	**وسائل التطهير والتعقيم** الأدوات يجب أن تفرك بفرشاة بعد أن تغمس في المطهر قبل التعقيم					
96	لا داعي لترك الأدوات لتجف قبل دخولها لجهاز التعقيم لان جهاز التعقيم سوف يجففها تماما					
97	المنظار الرئوي يكفي ان يطهر بمحلول مطهر بعد كل مريض.					

التحديات التي تعيق مقدمين الخدمات الصحية من تطبيق وسائل مكافحة العدوى البيئية
الرجاء تسجيل مدى موافقتك على هذه العبارات بوضع إشارة x أمام احد هذه الخيارات
1- معارض بشدة 2 - غير موافق 3- محايد 4- موافق 5- موافق بشدة

الرقم	العبارة	موافق بشدة	موافق	محايد	غير موافق	معارض بشدة
98	البنية التحتية وتصميم العانية المركزة لا يبدو ملائم لمكافحة العدوى البيئية					
99	يوجد نقص في المواد والأدوات اللازمة لمكافحة العدوى البيئية					
100	يوجد نقص في المعرفة والتعليم حول مكافحة العدوى البئية					
101	التدريب حول مكافحة العدوى البئية غير كاف					
102	يوجد صعوبة في الفهم والاستيعاب على الرغم من التعليم و التدريب					
103	عدم الرضا الوظيفي					
104	قلة الوقت وازدياد ضغط العمل					
105	قلة الموارد البشرية					
106	عدم وجود مساعد ممرض					
107	قلة القوانين الداعمة وبرامج المراقبة					
108	قلة الساعَلَة والتغذية الراجعة من المسئولين					
109	قلة التوجيهات من الزملاء والمسئولين					

Annex No. 16 Environmental infection control measures " checklist results"

Ventilation, Filtration and Pressurization

No.	Item	Finding	
		Shifa	EGH
1	Availability of HEPA (High efficiency particulate air) filters	yes	yes
2	HEPA filters are available in the isolation room with positive pressure.	yes	yes
3	There is more than one isolation room in the unit.	no	yes
4	Availability of negative pressure	no	no

Waterborne infectious pathogens

No.	Item	Finding	
		Shifa	EGH
1	Count of total coliform in tap water.	Negative	Negative
2	Count of total coliform in drinking water	Negative	Negative
3	Count of total coliform in water from disinfectant basin.	Negative	NA
4	Count of fecal coliform in tap water.	Negative	Negative
5	Count of fecal coliform in drinking water.	Negative	Negative
6	Count of fical coliform in water from disinfectant basin	Negative	NA
7	Presence of *pseudomonas* in tap water .	Negative	Negative
8	Presence of *pseudomonas* in drinking water	Negative	Negative
9	Presence of *pseudomonas* in water from disinfectant basin	Negative	NA
10	Presence of pathogenic bacteria in ventilator heated humidifier water.	Positive	Positive

Hand washing facilities fitness

No.	Item	Finding	
		Shifa	EGH
1	Available water is high quality (no visible pollution indicator as verdigris or deposited materials)	yes	yes
2	Liquid soap is available at all sinks in a special container	no	yes
3	No soaked instruments in sink area.	no	yes
4	Paper towels are available at all sinks.	no	no
5	Access to hand washing sinks is clear.	yes	yes
6	The sinks are free from used equipment e.g. soaked instruments.	no	yes
7	Hand washing poster is available.	no	no
8	Elbow operated mixer tap are available in the sinks.	yes	no
9	Hand rub is available in area wherein hand washing sink is not accessible.	no	no

Environmental surfaces fitness and cleaning

No.	Item	Finding	
		Shifa	EGH
1	The floor is covered with antistatic material.	yes	yes
2	The floor is cleaned & disinfected thoroughly during the day & regularly when get dirty.	yes	yes
3	The walls with impervious, antistatic paint washable should be painted and impervious to moisture.	yes	yes
4	Chair, tables, telephone & nursing counter. should be clean, free from dust & disinfected daily.	no	yes
	Clean uniforms are available every shift for everyone of staff members	no	no
5	The walls, ceiling, sinks & waste containers are disinfected periodically according to schedule	no	no
6	Water tap, sinks are disinfected daily & regularly when get dirty.	no	no
7	Bath room and Toilet have been cleaned following patients use.	no	yes
8	All sterile product are stored above floor level, no storage below 8-10 inches from floor.	no	no
9	No storage above 18-20 inches from ceiling.	yes	no
10	Space and ventilation is adequate in storage rooms.	no	no
11	Items are protected against dust, moisture, insects and extremes of temperature and humidity in storage rooms.	no	no
12	Thermometer present in storage room.	no	no

Instruments and Equipments fitness and cleaning

No.	Item	Finding	
		Shifa	EGH
1	Medical instruments are sterile and in a good state of use. (dressing sets, central line sets).	yes	yes
2	Medical equipments (monitors, ventilators , infusion pumps, syringe pumps) are clean, disinfected & free from dust.	no	no
3	Resuscitation equipments are clean, disinfected and free from dust (Ambu bag, mask & laryngoscope).	no	No
4	Availability of sterile and non- sterile gloves.	yes	yes
5	Availability of eye protection.	no	no
6	Availability of plastic disposal aprons.	no	no
7	Availability of sterile and non sterile gowns.	no	yes
8	Availability of surgical masks / N95 mask.	yes	yes
9	Oxygen humidifier is kept dry when not used.	no	no
10	Suction bottle is kept dry and clean when not used.	no	no
11	Bed frames and side rails are clean, free from dust.	no	no
12	Bed bath basin are clean and available.	no	yes
13	Bath trolley is disinfected after each use.	no	no
14	Dressing trolley is disinfected after each use.	no	no

Laundry

No.	Item	Finding	
		Shifa	EGH
1	**Linen** Special bags are available for dirty linen.	no	yes
2	Water-soluble bags are available for soiled linen to be disposed by another double bags.	no	no
3	Labels are available for soiled linens.	no	no
4	Bags are less than 2/3 full and are capable to being secure.	no	no
5	Clean linens are stored in a clean area (not in the dirty utility /bathroom).	no	no
6	**Mattresses and Pillows** Bed mattress and pillows are covered with moisture-resistant cover as the first layer, however soft cotton cover is the second layer.	no	no
7	Bed mattress and pillows are clean and free from wet spots**.**	no	no
8	No sign of needle sticking in bed mattress and pillows.	yes	yes
9	Clean and disinfected moisture-resistant mattress covers are available to be changed between patients.	no	no

Healthcare waste

No.	Item	Finding	
		Shifa	EGH
1	Correct segregation of waste: domestic, infectious, and cytotoxic	no	no
2	The three colored bags for segregation of waste is available.	no	no
3	Waste bag are disposed of at 2/3 full .	no	no
4	Persons handling wastes wear heavy gloves & closed shoes.	no	no
5	Materials post infected dressing are collected in a bag and closed well	no	no
6	**Sharps disposal** Puncture resistant sharp containers are available.	yes	yes
7	Sharp containers properly sealed prior to disposal.	no	yes
8	Sharp box is less than 3/4 full before disposing.	no	yes
9	Easily accessible /not blocked.	yes	yes
10	Sharp box is located in appropriate areas .	yes	yes
11	There is sharp disposal container in each unit.	yes	yes
12	The filled sharp containers sent to incinerator.	yes	yes
13	The surrounding environment is clean.	yes	yes

Antiseptic and disinfection

No.	Item	Finding	
		Shifa	EGH
1	Ethyl alcohol 70% is available as antiseptic.	yes	yes
2	Alcohol swap container is kept closed most of the time when not in use	yes	yes
3	Betadine 10% is available as antiseptic.	yes	yes
4	Chlorine is available as antiseptic for surface area	yes	yes
5	Chlorine used for floor disinfectant in concentration of 1000 per million (20ml Chlorine 5% in 1 letter water)	yes	no
6	Blood spots are cleaned by paper or tissue towels for absorbent that disposed immediately then disinfected by another towel with high concentration disinfectant (chlorine 5000 per million)	no	no

Annex No. 17 Swab cultures results

Environmental surfaces swab cultures results by use of TSB October 2012

No.	Site	Bacteria	
		Shifa	EGH
1	Nursing counter	*Pseudomonas*	*Klebsilla*
2	Telephone	*Pseudomonas*	*Pseudomonas*
3	The walls	*Staph* (normal flora)	*Pseudomonas*
4	Ceiling (condition vent)	*klebsilla*	*Staph arues*
5	Waste containers	*E-coli*	*E-coli*
6	Water tap	*E-coli*	*Staph arues*
7	Sinks	*Pseudomonas*	*Klebsilla*
8	Toilet (water tap)	*Pseudomonas*	*E-coli*
9	Siphon hand	*Pseudomonas*	*E-coli*
10	Clean linens	*E-coli*	*Pseudomonas*
11	Mattresses	*Pseudomonas E-coli*	*E-coli*
12	Pillows	*Pseudomonas*	*Klebsilla*
13	Bed frames.	*klebsilla*	*Pseudomonas*
14	Nurse uniform	*E-coli*	*E-coli*

Instruments and Equipments swab cultures results by use of TSB, October 2012.

No.	Site	Bacteria	
		Shifa	EGH
1	Blood gas analyzers	*Pseudomonas*	*Pseudomonas*
2	dressing sets, central line sets	Negative	Negative
3	Monitors cables	*Pseudomonas*	*Pseudomonas*
4	Monitor	*E-coli*	*E-coli*
5	Resuscitation equipments (Ambu bag	*Pseudomonas*	*Pseudomonas*
6	Ambu mask	*Pseudomonas*	*Pseudomonas*
7	Heated humidifier	*E-coli*	*Staph arues*
8	laryngoscope	*klebsilla*	*E-coli*
9	Patient unit (, infusion pumps, syringe pumps)	*Pseudomonas*	*E-coli*
10	Oxygen humidifier	*Pseudomonas*	*Staph arues*
11	Ventilator	*negative*	*Staph arues*
12	Suction irrigation bottle	*E-coli*	*Klebsilla*
13	Wash basins	*Staph arues*	Negative –sterile
14	Soiled suction bottle after disinfection.(by worker)	*Pseudomonas E-coli*	Negative
15	Rubber piping on a suctioning machine	*Klebsilla, Pseudomonas*	*Klebsilla, Pseudomonas*
16	Dressing trolley	*E-coli*	*Klebsilla,*
17	Bath trolley	*E-coli*	*E-coli*

Annex No. 18 Swab cultures results by two different technique

Environmental surfaces swab cultures results in Shifa, November 2012.

No.	Site	Bacteria	
		TSB for 24hr	Saline, direct
1	Nursing counter	*klebsilla*	etrobacter
2	Telephone	*Pseudomonas*	acintobacter
3	The walls	*Staph (*normal flora)	Negative
4	Ceiling (condition vent)	*klebsilla*	dephteroids
5	Waste containers	*E-coli*	Negative
6	Water tap	*E-coli*	Negative
7	Sinks	*klebsilla*	Negative
8	Toilet (water tap)	*Pseudomonas*	Negative
9	Siphon hand	*E-coli*	Negative
10	Clean linens	*E-coli*	Negative
11	Mattresses	*Pseudomonas* *E-coli*	Staph spp bacillus
12	Pillows	*Pseudomonas*	Negative
13	Bed frames.	*klebsilla*	*Pseudomonas*
14	Nurse uniform	*E-coli*	Negative

Instruments and Equipments swab cultures in Shifa, November 2012.

No.	Site	Bacteria	
		TSB for 24hr	Saline, direct
1	Blood gas analyzers	*Pseudomonas*	Etrobacter
2	dressing sets, central line sets	Negative	Acintobacter
3	Monitors cables	*Pseudomonas*	Negative
4	Monitor	*E-coli*	Dephteroids
5	Resuscitation equipments (Ambu bag	*Pseudomonas*	Negative
6	Ambu mask	*Pseudomonas*	Negative
7	Heated humidifier	*E-coli*	Negative
8	laryngoscope	*klebsilla*	Negative
9	Patient unit (, infusion pumps, syringe pumps)	*Pseudomonas*	Negative
10	Oxygen humidifier	*Pseudomonas*	Negative
11	Ventilator	*negative*	Staph spp bacillus
12	Suction irrigation bottle	*E-coli*	Negative
13	Wash basins	*Staph arues*	*Pseudomonas*
14	Soiled suction bottle after disinfection.(by worker)	*Pseudomonas* *E-coli*	Negative

Annex No. 19 Healthcare Providers Knowledge

1. Air & ventilation system

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	The suitable temperature level in ICU is (16-20)	35	74.5	12	25.5	17	65.4	9	34.6
2	The suitable humidity level in ICU is (50 -70)%	39	83.0	8	17.0	23	88.5	3	11.5
3	In positive pressure areas, filtration efficiency should be at 90 percent efficiency in the supply airstream and return at 99.97% for a 0.3 µm sized particle.	40	85.1	7	14.9	24	92.3	2	7.7
4	In negative pressure areas filtration efficiency should be at 99.97 percent efficiency for a 0.3 µm sized particle in the supply airstream and return is none required .	37	78.7	10	21.3	22	84.6	4	15.4
5	Negative pressure is needed for immunocompromised patients in isolation rooms.	42	89.4	5	10.6	21	80.8	5	19.2
6	Windows and doors need to be opened as much as possible.	24	51.1	23	48.9	16	61.5	10	38.5
7	Minimum total air change per hour is equal or more than 3 air change per hour (ACH) in isolation rooms.	33	70.2	14	29.8	23	88.5	3	11.5
8	Differential pressure of positive pressure for immunocompromised patients isolation rooms is > - 8 Pa.	43	91.5	4	8.5	24	92.3	2	7.7
	Total	293	77.9	83	22.1	170	81.7	38	18.3

2. Water quality and hand washing

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Hand rub is the most proper way for infection control.	34	72.3	13	27.7	19	73.1	7	26.9
2	Elbow operated mixer tap need to be available in the sinks.	7	14.9	40	85.1	5	19.2	21	80.8
3	Hand rub need to be available in area wherein hand washing sink is accessible.	34	72.3	13	27.7	19	73.1	7	26.9
	Total	75	53.2	66	46.8	43	55.1	35	44.9

3. Environmental surfaces

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	The floor should be covered with antistatic material.	6	12.8	41	87.2	2	7.7	24	92.3
2	Walls should be disinfected periodically according to schedule.	6	12.8	41	87.2	1	3.8	25	96.2
3	All sterile product are stored above floor level, no storage below 100 cm from floor	47.0	100.0	0	0.0	26	100.0	0	0.0
4	Storage should not be above 100 cm from ceiling.	43	91.5	4	8.5	23	88.5	3	11.5
	Total	102	54.3	86	45.7	52	50.0	52	50.0

4. Instruments and Equipments

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Oxygen humidifier should not changed between patients.	35	74.5	12	25.5	20	76.9	6	23.1
2	Medical equipment as monitors, ventilator, infusion pumps and syringe pumps should not be disinfected daily & between patients because of working by electricity.	14	29.8	33	70.2	18	69.2	8	30.8
3	Monitors cables should not be disinfected daily & between patients to keep from damage.	23	48.9	24	51.1	11	42.3	15	57.7
4	**Total**	72	51.1	69	48.9	49	62.8	29	37.2

5. Suctioning of sputum secretion

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Suction bottle should kept dry when not used	18	38.3	29	61.7	12	46.2	14	53.8
2	Disinfectant solution would be used to irrigate suction tubes	38	80.9	9	19.1	22	84.6	4	15.4
3	Irrigation container should be disposable	18	38.3	29	61.7	14	53.8	12	46.2
4	**Total**	74	52.5	67	47.5	48	61.5	30	38.5

6. Laundry

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Soiled linen should be disposed in a water-soluble bags.	9	19.1	38	80.9	7	26.9	19	73.1
2	Soiled linens should not be labeled.	28	59.6	19	40.4	18	59.2	8	30.8
	Total	37	39.4	57	60.6	25	48.1	27	51.9

Mattresses and Pillows

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Bed mattress and pillows should be covered with moisture-resistant as the first layer, however soft cotton cover is the second layer.	6	12.8	41	87.2	1	3.8	25	96.2
2	Needles should not be stick into the mattress through the cover.	2	4.3	45	95.7	2	7.7	24	92.3
3	Clean and disinfect moisture-resistant mattress covers should replaced between patients.	10	21.3	37	78.7	9	34.6	17	65.4
	Total	18	12.8	123	87.2	12	15.4	66	84.6

7. Medical waste management

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Correct segregation of waste should be in two bags.	45	96.7	2	4.3	23	88.5	3	11.5
2	Waste bag should disposed of at complete full .	18	83.3	29	61.7	14	53.8	12	46.2
	Total	63	67.0	31	33.0	37	71.2	15	28.8

Sharp disposal

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Used needles should be removed from syringes before disposal.	40	85.1	7	14.9	17	65.4	9	34.6
2	Used needles should be bended prior disposal.	12	25.5	35	74.5	8	30.8	18	69.2
3	Sharp box should less than 1/2 full before disposing .	31	66.0	16	34.0	15	57.7	11	42.3
	Total	83	58.9	58	41.1	40	51.3	38	48.7

8. Disinfection and Sterilization

No.	Item	Shifa hospital				EGH			
		f	%	f	%	f	%	f	%
		Non Correct		Correct		Non Correct		Correct	
1	Chlorine used for floor disinfectant should be in concentration of 1000 per million (20ml Chlorine 5% in 1 liter water)	32	68.1	15	31.9	13	50.0	13	50.0
2	Chemical indicator for sterility not so important.	18	83.3	29	61.7	15	57.7	11	42.3
3	Paper indicator for sterility is so important .	25	63.2	22	46.8	15	57.7	11	42.3
4	Blood spots should not be cleaned by paper or tissue towels for absorbent that disposed immediately then disinfected by another towel with normal concentration disinfectant (chlorine 1000 per million)	45	95.7	2	4.3	26	100.0	0	0.0
5	Instruments should be soaked in disinfectant for 10 minutes before send to sterilization	15	31.9	32	68.1	6	23.1	20	76.9
6	The laryngoscope should be sterilized after each use.	41	87.2	6	12.8	23	88.5	3	11.5
	Total	176	62.4	106	37.6	98	62.8	58	37.2

Annex No. 20 Comparison between nurses and doctors performance

1. **Keeping air quality at unit environment**

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Windows and doors are kept closed as much as possible	8	21.1	30	78.9	23	76.7	7	23.3
2	Alter accepted temperature level by change setting of air conditioning according to persons desire.	19	50.0	19	50.0	9	30.0	21	70.0
3	**Total**	27	35.5	49	64.5	32	53.3	28	46.7

2. **Hand washing**

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Immediately on arrival to the unit	21	55.3	17	44.7	22	73.3	8	26.7
2	Before touching the patients.	38.0	100.0	0	0.0	29	96.7	1	3.3
3	After working with patients.	10	26.3	28	73.7	4	13.3	26	86.7
4	Before leaving the unit.	21	55.3	17	44.7	5	16.7	25	83.3
5	Before performing a septic invasive procedures.	6	15.8	32	84.2	21	70.0	9	30.0
6	After touching blood or body fluids.	4	10.5	34	89.5	4	13.3	26	86.7
7	After removing gloves.	38	100.0	0	0.0	30	100.0	0	0.0
8	Removing jewelry, hand watch, and ring when washing hands.	8	21.1	30	78.9	12	40.0	18	60.0
9	Washing hands for 15-30 seconds with soap and running water	37	97.4	1	2.6	27	90.0	3	10.0
10	Drying hands with clean paper towel if available	21	55.3	17	44.7	14	46.7	16	53.3
11	Turn of water after hand washing using paper towel. If elbow mixer not available	38	100.0	38	00.0	30	100.0	0	00.0
12	Use Hand rub in area wherein hand washing sink is not accessible	38	100.0	0	0.0	30	100.0	0	0.0
	Total	142	62.3	86	37.7	113	62.8	67	37.2

3. Uniform

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	All health care providers wear uniform during duty.	0	0.0	38	100.0	17	56.7	13	43.3
	Total	0	0.0	38	100.0	17	56.7	13	43.3

4. Personal protective equipment (PPE) and Wearing gloves

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Personal protective equipment is correctly worn and maintained to negate the risk of infection /cross infection (face mask, sterile gowns)	22	57.9	16	42.1	20	66.7	10	33.3
2	Commitment to wear or use PPE when caring patients.	23	60.5	15	39.5	19	63.3	11	36.7
3	Wearing sterile gloves in appropriate way.	0	0.0	38	100.0	4	13.3	26	86.7
4	Wear gloves when contact with blood or other body fluids.	11	28.9	27	71.1	5	16.7	25	83.3
5	Use clean gloves when handling contaminated instrument.	11	28.9	27	71.1	9	30.0	21	70.0
6	Remove gloves in proper way	33	86.8	5	13.2	26	86.7	4	13.3
7	**Total**	100	43.9	128	56.1	83	46.1	97	53.9

5. Handle laundry linens in proper way

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Keep mattresses dry; discard them if they become and remain wet or stained.	34	89.5	4	10.5	m	m	m	m
2	Clean and disinfect mattress covers using disinfectants.	m	m	m	m	m	m	m	m
3	Replace mattress and pillow covers if they become torn or in need of repair.	25	65.8	13	34.2	m	m	m	m
4	Do not stick needles into the mattress through the cover.	0	0.0	38	100.0	0	0.0	0	00.0
5	Clean and disinfect moisture-resistant mattress covers are changed between patients	m	m	m	m	m	m	m	m
6	**Total**	100	43.9	128	56.1	0	0.0	0	00.0

6. Dealing with Instruments and Equipments

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Medical instruments are cleaned and disinfected between patients in proper way. (dressing sets, central line sets).	6	15.8	32	84.2	m	m	m	m
2	Monitors cables are clean, free from dust & disinfected daily & between patients. (culture will be done to detect infectious pathogens)	30	78.9	8	21.1	m	m	m	m
3	Soiled blood pressure cuff should be clean & disinfected between patients.	29	76.3	8	21.1	m	m	m	m
4	Patient unit (monitors, ventilators , infusion pumps, syringe pumps) are clean & free from dust. (culture will be done to detect infectious pathogens)	28	73.7	10	26.3	m	m	m	m
5	Medical equipment is disinfected after use. (dressing trolley , Ambu bag, mask & laryngoscope)	7	18.4	31	81.6	m	m	m	m
6	Bed frames are disinfected daily & between patients.	31	81.6	7	18.4	m	m	m	m
7	Wash basins are disinfected on a regular basis by using approved disinfectant as set by policies.	22	57.9	16	42.1	m	m	m	m
	Total	153	57.7	112	42.3	m	m	m	m

7. Instruments and Equipments of patient airway management

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Breathing tubes are changed if became soiled or malfunction for the same patient	0	0.0	38	100.0	m	m	m	m
2	Breathing tubes are changed between patients	0	0.0	38	100.0	m	m	m	m
3	Using sterile water in oxygen and heated humidifier.	0	0.0	16	42.1	m	m	m	m
4	Oxygen humidifier is changed between patients	38	100.0	0	0.0	m	m	m	m
5	Suction bottle are changed or evacuated every 24hr.	7	18.4	31	81.6	m	m	m	m
6	Soiled bottle are cleaned and disinfected properly before reuse. (culture will be done to detect infectious pathogens)	22	57.9	16	42.1	m	m	m	m
7	Irrigation for suction tubes are done by sterile water in a disposable cup.	16	42.1	22	57.9	m	m	m	m
	Total	83	34.0	161	66.0	m	m	m	m

8. Instruments and Equipments of invasive procedures.

1. Central Venous Catheter(CVC)

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Done under aseptic technique.	0	0.0	38	100.0	4	13.3	26	86.7
2	Scraping or surgical hand washing done before insertion catheter.	30.0	78.9	8	21.1	25	83.3	5	16.7
3	Sterile towels are available to maintain sterile field.	NA	NA	NA	NA	NA	NA	NA	NA
4	Mask, cap, and sterile gloves and gown must be worn for insertion.	38	100.0	0	0.0	28	93.3	2	6.7
5	Sterility is maintained during and after samples collection.	34	89.5	4	10.5	m	m	m	m
	Total	**102**	67.1	**50**	32.9	**57**	63.3	**33**	36.7

2. Peripheral Venous Catheter (PVC)

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Wear latex gloves before PVC insertion	33	86.8	5	13.2	25	83.3	5	16.7
2	Done under aseptic technique.	17	44.7	21	55.3	13	43.3	17	56.7
3	Removed after 24 hr post admission from emergency room	38	100.0	0	0.0	30	100.0	0	0.0
4	Change of dressing on **(PVC)** performed daily.	38	100.0	0	0.0	33	86.8	5	13.2
5	Replace PVC every 72 hours or when malfunction before 72 hrs.	9	23.7	29	76.3	m	m	m	m
6	Date of insertion is written on PVC	10	56.3	28	73.7	m	m	m	m
	Total	145	63.6	83	36.4	101	78.9	27	21.1

3. IV fluids and medication

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Disinfection performed when using a multi dose vial.	38	100.0	0	0.0	30	100.0	0	0.0
2	Multi dose vial labeled with the name, date, time of preparation. & concentration of dilution	13	34.2	25	65.8	m	m	m	m
3	Multi dose vials are kept in fridge after dilution for next dose use.	38	100.0	0	0.0	m	m	m	m
4	Intravenous lines of solutions given by infusion or syringe pump are changed every 72 hours	38	100.0	0	0.0	m	m	m	m
5	Intravenous lines are changed after the transfusion of blood or intralipids, and for discontinuous perfusions.	25	65.8	13	34.2	m	m	m	m
6	Intravenous lines of Central Venous pressure CVP manometer are changed every 72 hours	38	100.0	0	0.0	m	m	m	m
	Total	190	83.3	38	16.7	30	100.0	0	0.0

4. Folly's Catheter

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Scraping or surgical hand washing done before insertion catheter.	25	65.8	13	34.2	23	76.7	7	23.3
2	Done under aseptic technique.	7	18.4	31	81.6	8	26.7	22	73.3
3	Sterile towels are available to maintain sterile field.	30	100.0	0	0	30	100.0	0	0.0
4	Sterility is maintained during and after samples collection.	3	7.9	35	92.1	2	6.7	28	93.3
5	Urine bag is hanged on bed under the level of patients & above the floor	25	65.8	13	34.2	30	100.0	0	0.0
6	**Total**	90	49.5	92	50.5	93	62.0	57	38.0

9. Use of antiseptics and disinfectant solutions

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Sterile field is established and maintained during procedures.	9	23.7	29	76.3	6	20.0	24	80.0
2	Ethyl alcohol (70%) swap is used to clean the skin by gently scrubbing before invasive procedures.	0	0.0	38	100.0	0	0.0	30	100.0
3	Skin is allowed to dry or dried by sterile gauze before beginning the invasive procedure when alcohol is used.	38	100.0	0	0.0	28	93.3	2	6.7
4	Betadine is allowed to remain over skin 1-2 minutes before proceeding	27	71.1	11	28.9	22	73.3	8	26.7
5	Instruments are brushed well before soaked in disinfectant.	13	34.2	25	65.8	m	m	m	m
6	Instruments are soaked in chlorine disinfectant 0.5% for 10 minutes before send to sterilization or as manufacture instruction for other disinfectant solutions.	27	71.1	11	28.9	m	m	m	m
	Instruments are allowed to dry before send to sterilization.	28	73.7	10	26.3	m	m	m	m
	Total	142	53.4	124	46.6	**56**	46.5	**64**	30.5

10. Healthcare waste management

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Segregation of infectious waste in any proper way as possible.	34	89.5	4	10.5	28	93.3	2	6.7
2	Suction catheter is disposed properly after doing suction .	33	86.8	5	13.2	28	93.3	2	6.7
3	**Total**	67	88.2	9	11.8	28	93.3	2	6.7

11.Discarding sharp disposal properly

No.	Item	Nurse				Doctor			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Do not remove used needles from syringes before disposal.	16	42.1	22	57.9	11	36.7	19	63.3
2	Do not bend or break used needles prior disposal.	0	0.0	38	100.0	0	0.0	30	100.0
3	Do not recap used needles.	25	65.8	13	34.2	24	80.0	6	20.0
4	Dispose all sharps in puncture resistance containers.	6	15.8	32	84.2	18	60.0	12	40.0
	Total	47	30.9	105	69.1	53	44.2	67	55.8

Annex No. 21 Comparison between HCPs performance in Shifa Hospital and EGH

1. Keeping air quality at unit environment

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Windows and doors are kept closed as much as possible	26	60.5	17	39.5	5	20.0	20	80.0
2	Alter accepted temperature level by change setting of air conditioning according to persons desire.	3	7.0	40	93.0	25	100.0	0	0.0
3	**Total**	29	33.7	57	66.3	30	60.0	20	40.0

2. Hand washing

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Immediately on arrival to the unit	42	97.7	1	2.3	25	100.0	0	0.0
2	Before touching the patients.	8	18.6	35	81.4	6	24.0	19	76.0
3	After working with patients.	20	46.5	23	53.5	6	24.0	19	76.0
4	Before leaving the unit.	25	58.1	18	41.9	2	8.0	23	92.0
5	Before performing a septic invasive procedures.	4	9.3	39	90.7	4	16.0	21	84.0
6	After touching blood or body fluids.	39	90.0	4	10.0	21	84.0	4	16.0
7	Before wearing gloves.	17	39.5	26	60.5	3	12.0	**22**	**88.0**
8	After removing gloves.	39	90.7	4	9.3	25	100.0	0	0.0
9	Removing jewelry, hand watch, and ring when washing hands.	35	81.4	8	18.6	25	100.0	0	0.0
10	Washing hands for 15-30 seconds with soap and running water	43	100.0	0	0.0	25	100.0	0.0	0.0
11	Drying hands with clean paper towel if available	0	0.0	43	100.0	0	0.0	25	100.0
12	Turn of water after hand washing using paper towel. If elbow mixer not available	43	0.100	0.0	0.0	25	0.100	0.0	0.0
13	Use Hand rub in area wherein hand washing sink is not accessible	43	0.100	0.0	0.0	25	0.100	0.0	0.0
14	**Total**	358	64.0	201	36.0	192	59.0	133	41

3. Uniform

No.	Item	Shifa				EGH			
		F	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	All health care providers wear uniform during duty.	**17**	**39.5**	**26**	**60.5**	**0**	**0.0**	**25**	**1000**
2	Clean uniforms are available every shift for everyone of staff members	**43**	**100.0**	**0**	**0.0**	**25**	**100.0**	**0**	**0.0**
3	**Total**	60	69.8	26	30.2	25	50.0	25	50.0

4. Personal protective equipment (PPE) and Wearing gloves

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Personal protective equipment is correctly worn and maintained to negate the risk of infection /cross infection (face mask, sterile gowns)	**41**	**97.7**	**1**	**2.3**	**0.0**	**0.00**	**25**	**100.0**
2	Commitment to wear or use PPE when caring patients.	36	83.7	7	16.3	6	24.0	19	88.0
3	Wearing sterile gloves in appropriate way.	1	2.3	42	97.7	3	12.0	22	88.0
4	Wear gloves when contact with blood or other body fluids.	9	20.9	34	79.1	7	28.0	18	72.0
5	Use clean gloves when handling contaminated instrument.	7	16.3	15	34.9	4	16.0	21	84.0
6	Remove gloves in proper way	40	93.0	3	7.0	19	76.0	6	24.0
7	**Total**	134	56.8	102	43.2	39	26.0	111	74.0

5. Handle laundry linens in proper way

No.	Item	Shifa				EGH			
		F	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Keep mattresses dry; discard them if they become and remain wet or stained.	**20**	**46.5**	**2**	**4.7**	**14**	**56.0**	**2**	**8.0**
2	Clean and disinfect mattress covers using disinfectants.	**m**	**m**	**m**	**m**	**m**	**m**	**m**	**m**
3	Replace mattress and pillow covers if they become torn or in need of repair.	22	51.2	21	48.8	3	12.0	13	52.0
4	Do not stick needles into the mattress through the cover.	22	51.2	21	48.8	0	0.00	25	100.0
	Total	124	73.8	44	26.2	77	65.8	40	34.2

6. Dealing with Instruments and Equipments

No.	Item	Shifa				EGH			
		F	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Medical instruments are cleaned and disinfected between patients in proper way. (dressing sets, central line sets).	3	7.0	19	44.2	3	12.0	13	52.0
2	Monitors cables are clean, free from dust & disinfected daily & between patients. (culture will be done to detect infectious pathogens)	18	41.9	4	9.3	12	48.0	4	16.0
3	Soiled blood pressure cuff should be clean & disinfected between patients.	17	39.5	4	9.3	12	48.0	4	16.0
4	Patient unit (monitors, ventilators , infusion pumps, syringe pumps) are clean & free from dust. (culture will be done to detect infectious pathogens)	16	37.2	6	14.0	12	48.0	4	16.0
5	Medical equipment is disinfected after use. (dressing trolley , Ambu bag, mask & laryngoscope)	4	9.3	18	41.9	3	12.0	13	52.0
6	Bed frames are disinfected daily & between patients.	18	41.9	4	9.3	13	52.0	3	12.0
7	Wash basins are disinfected on a regular basis by using approved disinfectant as set by policies.	22	51.2	21	48.8	16	64.0	9	36.0
	Total	98	56.3	76	43.7	71	58.7	50	41.3

7. Instruments and Equipments of patient airway management

No.	Item	Shifa				EGH			
		F	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Breathing tubes are changed if became soiled or malfunction for the same patient	0	0.0	22	51.2	0	0.0	16	64.0
2	Breathing tubes are changed between patients	0	0.0	22	51.2	0	0.0	16	64.0
3	Using sterile water in oxygen and heated humidifier.	m	m	m	m	0	0	16	64.0
4	Oxygen humidifier is changed between patients	22	51.2	21	48.8	16	64.0	9	36.0
5	Suction bottle are changed or evacuated every 24hr.	3	7.0	19	44.2	4	16.0	12	48.0
6	Soiled bottle are cleaned and disinfected properly before reuse. (culture will be done to detect infectious pathogens)	22	51.0	0	0.0	16	64.0	0	0.0
7	Irrigation for suction tubes are done by sterile water in a disposable cup.	33	100.0	0	0.0	16	100.0	0	0.0
	Total	47	35.9	84	64.1	52	43.0	69	57.0

8. Instruments and Equipments of invasive procedure

1. Peripheral Venous Catheter (PVC)

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Wear latex gloves before PVC insertion	37	88.0	6	14.0	21	84.0	4	16.0
2	Done under aseptic technique.	20	46.5	23	53.5	10	40.015	60.0	
3	Removed after 24 hr post admission from emergency room	43	100.0	0	0.0	25	100.0	0	0.0
4	Change of dressing on **(PVC)** performed daily.	22	51.2	21	48.8	16	64.0	9	36.0
5	Replace PVC every 72 hours or when malfunction before 72 hrs.	5	11.6	17	39.5	4	16.0	12	48.0
6	Date of insertion is written on PVC	27	62.8	16	37.2	13	52.0	12	48.0
	Total	154	65.0	83	35.0	89	47.8	97	52.2

2.Central Venous Catheter(CVC)

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Done under aseptic technique.	3	7.0	40	93.0	1	4.0	24	96.0
2	Scraping or surgical hand washing done before insertion catheter.	37	86.0	6	14.0	18	72.0	7	28.0
3	Sterile towels are available to maintain sterile field.	m	m	m	m	m	m	m	m
4	Mask, cap, and sterile gloves and gown must be worn for insertion.	43	100.0	0	0.0	23	92.0	2	8.0
5	Sterility is maintained during and after samples collection.	18	41.9	25	58.1	16	64.0	9	36.0
	Total	101	58.7	71	41.3	58	58.0	42	42.0

3.IV fluids and medication

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Disinfection performed when using a multi dose vial.	43	100.0	0	0.0	25	100.0	0	0.0
2	Multi dose vial labeled with the name, date, time of preparation. & concentration of dilution	9	20.9	13	30.2	4	16.0	12	46.0
3	Multi dose vials are kept in fridge after dilution for next dose use.	22	51.2	21	48.8	16	64.0	9	36.0
4	Intravenous lines of solutions given by infusion or syringe pump are changed every 72 hours	22	51.2	0	0.0	16	64.0	0	0.0
5	Intravenous lines are changed after the transfusion of blood or intralipids, and for discontinuous perfusions.	22	51.2	21	48.8	3	12.0	13	52.0
6	Intravenous lines of Central Venous pressure CVP manometer are changed every 72 hours	22	51.2	21	48.8	16	64.0	9	36.0
	Total	140	64.8	76	35.2	80	65.0	43	35.0

4.Folly's Catheter

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Hand washing done before insertion catheter.	43	100.0	m	m	25	100.0	0	0.0
2	Done under aseptic technique.	11	25.6	32	74.4	4	16.0	21	84.0
3	Sterile towels are available to maintain sterile field.	m	m	m	m	m	m	m	m
4	Sterility is maintained during and after samples collection.	0	0.0	43	10.0	5	20.0	20	80.0
5	Urine bag is hanged on bed under the level of patients & above the floor	22	51.2	21	48.8	3	12.0	13	52.0
6	**Total**	37	27.8	96	72.2	37	40.7	54	59.3

9. Use of antiseptics and disinfectant solutions

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Sterile field is established and maintained during procedures.	10	23.3	33	76.7	5	20.0	20	80.0
2	Ethyl alcohol (70%) swap is used to clean the skin by gently scrubbing before invasive procedures.	0	0.0	43	100.0	0	0.0	25	100.0
3	Skin is allowed to dry or dried by sterile gauze before beginning the invasive procedure when alcohol is used.	43	100.0	0	0.0	23	92.0	2	8.0
4	Betadine is allowed to remain over skin 1-2 minutes before proceeding	41	95.3	2	4.7	8	32.0	17	68.0
5	Instruments are brushed well before soaked in disinfectant.	10	23.3	12	27.9	3	12.0	13	52.0
6	Instruments are soaked in chlorine disinfectant 0.5% for 10 minutes before send to sterilization or as manufacture instruction for other disinfectant solutions.	22	51.2	21	48.8	2	20.0	11	44.0
	Instruments are allowed to dry before send to sterilization.	22	51.2	21	48.8	6	24.0	10	40.0
	Total	148	52.9	132	47.1	47	32.4	98	67.6

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10. Healthcare waste management

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Segregation of infectious waste in any proper way as possible.	43	100.0	0	0.0	21	84.0	4	16.0
2	Suction catheter is disposed properly after doing suction .	21	48.8	1	2.3	12	48.0	4	16.0
3	**Total**	64	98.5	1	1.5	33	80.5	8	19.5

11. **Discarding sharp disposal properly**

No.	Item	Shifa				EGH			
		f	%	f	%	f	%	f	%
		No		Yes		No		Yes	
1	Do not remove used needles from syringes before disposal.	11	25.6	32	74.7	16	64.0	9	36.0
2	Do not bend or break used needles prior disposal.	0	0.0	43	100.0	0	0.0	25	100.0
3	Do not recap used needles.	42	97.7	1	2.3	7	28.0	18	72.0
4	Dispose all sharps in puncture resistance containers.	19	44.2	24	55.8	5	20.0	20	800
	Total	72	41.9	100	58.1	28	28.0	72	72.0